COMPUTATIONAL NUCLEAR FORENSICS ANALYSIS OF WEAPONS-GRADE PLUTONIUM SEPARATED FROM FUEL IRRADIATED IN A THERMAL REACTOR

A Thesis

by

TAYLOR MARIE COLES

Submitted to the Office of Graduate and Professional Studies of
Texas A&M University
in partial fulfillment of the requirements for the degree of

MASTER OF SCIENCE

Chair of Committee, Sunil Chirayath
Committee Members, William Charlton
Wolfgang Bangerth
Head of Department, Yassin Hassan

May 2014

Major Subject: Nuclear Engineering

ABSTRACT

The objective of this thesis work is to utilize computational models to reliably predict the intrinsic signature of the weapons-grade plutonium separated from a Pressurized Heavy Water Reactor (PHWR), specifically an Indian 220 MWe PHWR. The PHWR produced weapons-grade plutonium due to the low-burnup seen by the fuel in the computational model. The computational modeling for this project was completed using MCNPX-2.7 radiation transport code. MCNPX-2.7 was used to perform burnup calculations for the PHWR in able to determine the resulting isotopic makeup of actinides and trace elements found in the discharged fuel.

The discharged fuel of interest was a single bundle of natural uranium fuel which had undergone a burnup of about 1 GWd/tU. During the PHWR core burnup simulation, certain fuel channels were reshuffled and replaced with a number of new or "fresh" fuel bundles to simulate the process of refueling the reactor; however, it was later determined that utilizing a computational model of a single bundle with reflective boundary conditions on all sides was sufficient in producing the necessary data. That single bundle was burnt to the desired burnup and the final fuel composition of that bundle was used in the isotopic analysis.

The specific fission products and actinides selected for this analysis were chosen based upon five parameters; the amount of production, half-life, activity, probability of detection, and the Plutonium Uranium Extraction Process (PUREX) decontamination factor. An uncertainty analysis associated with Monte Carlo methodology was

completed using the computational model to predict the mean and standard deviation of the amount of production from the PHWR. Ratios of the selected isotopes concentrations and activities per 1 Kg of total plutonium with a decontamination factor of 10^6 were calculated for the PHWR.

The intrinsic signature of the PHWR was also compared to that from a Fast Breeder Reactor (FBR), and a ratio of the PHWR results to the FBR results was completed to determine if noticeable differences could be seen between the two reactor types, hence, proving the existence of identifyable intrinsic physical signatures in separated weapons-grade plutonium produced by differing reactor types. Ultimately, if smuggled weapons-grade plutonium is intercepted, an analysis of isotopic signatures would be able to attribute the material back to a source reactor. The future work would include experimental data collected after single fuel pellets of natural uranium fuel have been irradiated to the desired burnup in the Oak Ridge National Laboratory- High Flux Isotope Reactor (ORNL-HFIR), and then separated using the PUREX process to experimentally determine the intrinsic signature of the fuel. The experimental data is not yet available.

DEDICATION

To my fiancé, Brandon, for his unconditional love and support, even when it meant living in different states and driving 960 miles round trip to see each other.

ACKNOWLEDGEMENTS

I would like to acknowledge the efforts of my advisor, Dr. Chirayath, and my committee members, Dr. Charlton and Dr. Bangerth, for their crucial aid and patience throughout this project. Last, but not least, I would like to acknowledge Dr. Boyle for his willingness to step in as an alternate committee member at the last minute.

I would also like to acknowledge the funding support from NSF and DHS joint ARI program (NSF Grant No. ECCS-1140018 and DNDO-2012-DN-077-ARI1057-02) to carry out this research work.

NOMENCLATURE

AGR- Advanced Gas-Cooled Reactor

ASNO- Australian Safeguards and Non-Proliferation Office

BAPL- Bettis Atomic Power Laboratory

BWR- Boiling Water Reactor

DF- Decontamination Factor

DHRUVA- India's Largest Research Reactor

FBR- Fast Breeder Reactor

GCR- Gas Cooled Reactor

HFIR- High-Flux Isotope Reactor

IAEA- International Atomic Energy Agency

ITU- Institute for Transuranium Elements

ITWG- International Technical Working Group

LWR- Light Water Reactor

MCNP- Monte Carlo Neutral Particle

MOX- Mixed Oxide

NPT- Non-Proliferation Treaty

NSG- Nuclear Suppliers Group

ORNL- Oak Ridge National Laboratory

PHWR- Pressurized Heavy Water Reactor

PUREX- Plutonium Uranium Recovery by EXtraction

PWR- Pressurized Water Reactor

RBMK- Reaktor Bolshoy Moshchnosty Kanalny or Russian Channel-Type Reactor

SNM- Special Nuclear Material

SQ- Significant Quantity

TBP- Tri-butyl Phosphate

UO_2- Uranium Dioxide

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I. INTRODUCTION

I.A. Background and Motivations

Plutonium isotopes (^{238}Pu, ^{239}Pu, ^{240}Pu, ^{241}Pu, and ^{242}Pu) constitute the "Pu vector" and are produced in the irradiated nuclear reactor fuel. The isotopic composition of the Pu vector is dependent upon the amount of fuel burnup, the nature of the neutron energy spectrum to which the fuel was exposed, reactor operating history, and the amount of time since the irradiation occurred. Analysis of the resulting Pu vector in the discharged fuel may be able to provide the type of reactor that produced the plutonium. Fuel burnup is the major contributing factor to the Pu vector characteristics. As the fuel burnup increases, the amount of heavier plutonium isotopes increases because of the neutron captures in ^{239}Pu and successive plutonium isotopes. The production of ^{239}Pu begins with a neutron capture reaction

$$ {}^{1}_{0}n + {}^{238}_{92}U \rightarrow {}^{239}_{92}U \xrightarrow{\beta^-} {}^{239}_{93}Np \xrightarrow{\beta^-} {}^{239}_{94}Pu \qquad (1) $$

to produce ^{239}U, and then two sucessive betta decays occur to produce ^{239}Pu. The buildup of various plutonium isotopes as burnup increases for a typical Pressurized-Water Reactor (PWR) is shown on the following page in Fig.1.[1] It should be noted in Fig. 1 that plutonium is not present when the fuel has undergone zero burnup, but rather begins to buildup in the reactor at a burnup very close to the beginning of the life of the reactor core. For a standard light-water reactor with burnup around 40 MWd/Kg, the resulting plutonium would be about 56% ^{239}Pu.[2] Therefore, the resulting plutonium from a typical PWR is considered reactor-grade.[1] The typical levels of plutonium achieved in

various power reactors is displayed in Table I[2], and the properties of the Pu vector which define plutonium grade are listed in Table II.[1]

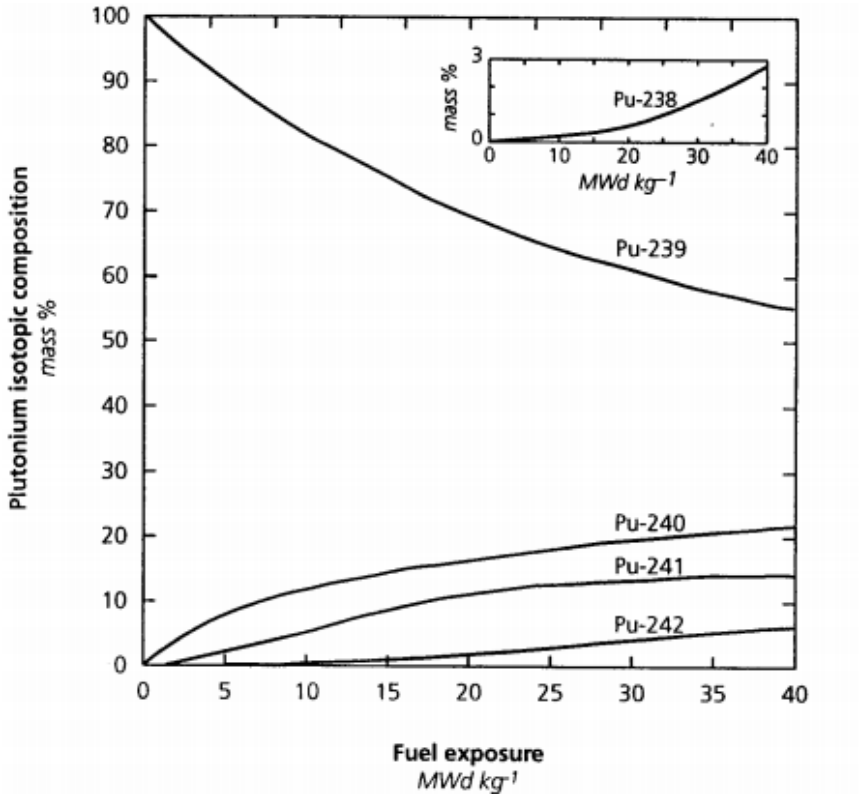


Fig. 1. Plutonium isotopic composition as a function of fuel burnup in a PWR.[1]

TABLE I

Typical Isotopic Compositions of Spent Fuel Discharged From Power Reactors[2]

Reactor Type	**Fuel burn-up (GWd/tU)**	**Isotopic Composition (%)**			
		^{239}Pu	^{240}Pu	^{241}Pu	^{242}Pu
GCR	3.6	77.9	18.1	3.5	0.5
PHWR	7.5	66.4	26.9	5.1	1.5
AGR	18	53.7	30.8	9.9	5.0
RBMK	20	50.2	33.7	10.2	3.3
BWR	27.5	59.8	23.7	10.6	3.3
PWR	33	56.0	24.1	12.8	5.4

TABLE II

Approximate Isotopic Composition of Various Plutonium Grades[1]

Grade	**Isotopic Composition (%)**				
	^{238}Pu	^{239}Pu	^{240}Pu	^{241}Pu	^{242}Pu
Super-grade	-	98.0	2.0	-	-
Weapons-grade	0.12	93.8	5.8	0.25	0.022
Reactor-grade	1.3	60.3	24.3	9.1	5.0
MOX-grade	1.9	40.4	32.1	17.8	7.8
FBR blanket	-	96.0	4.0	-	-

Weapons-grade plutonium will be produced if uranium is subject to a low-burnup of about 1 GWd/tU, irrespective of the reactor type in which the uranium is irradiated. It

is unusual for a power reactor to discharge fuel at that low of a burnup. During the normal operation of a Fast Breeder Reactor (FBR), depleted uranium used in the peripheral region of the reactor core (blanket region) will be exposed only to a burnup around 1 GWd/tU when discharged. It is possible to intentionally discharge fuel from a power reactor at a low-burnup. If a reactor were to discharge fuel with a burnup near 1 GWd/tU, although the mass of plutonium produced will be significantly less than that in a higher burnup scenario, the plutonium produced will be weapons-grade.

Typical power reactors require a shutdown in order to carry out the fuel discharge. However, Pressurized Heavy Water Reactors (PHWRs) are refueled while in operation, this is known as online refueling. Therefore, any country operating this reactor type has the ability to produce weapons-grade plutonium in significant quantities. The PHWR and FBR reactor types are of particular interest due to the nuclear development in China and India.

Along with being a non-signatory to the Non-Proliferation Treaty (NPT), India has proven itself to be a nuclear-weapons capable state. India conducted its first nuclear test in 1974 to test a "design of explosives for peaceful purposes".[3] It is estimated that "India would have had, at the end of 2006, sufficient plutonium to produce 69 implosion weapons (considering 6 kilograms of plutonium used for each weapon), [and] if adequate uranium production is available to fuel DHRUVA, an additional four weapons a year can be maintained."[4] The United States and India began discussions in 2005 of a deal that would provide full civil nuclear cooperation between the countries. India would allow international safeguards on their civilian reactors in exchange for the purchase of

nuclear technologies and fuel from the Nuclear Suppliers Group (NSG).[5] In accordance with the Indo-US 123 agreement and India's separation plan, all civilian reactors will be placed under International Atomic Energy Agency (IAEA) safeguards; however, India retains the sole right to determine which of their reactors are civilian.[6] Also, all fuel material brought from outside of India is restricted to be used only in Indian civilian reactor. If India uses the PHWRs and FBRs only to meet their civilian energy needs, international safeguards would be in place, which will provide confidence that plutonium is not being diverted from their power plants. Thus per the agreement, fourteen of their twenty-two current PHWRs will be placed under IAEA safeguards. Hence, 8 PHWRs and India's FBRs will not be subjected to international safeguards.[5]

China is a weapons state, and a signatory of the NPT. China exploded its first weapon in 1964, and is estimated to have about 380 warheads consisting of both plutonium and uranium weapons. China is a market for heavy water as well as natural uranium (fuel used in heavy water reactors), and China has not been consistent regarding their enforcement of safeguards on exports.[3] China is also pursuing the use of FBRs for research and power production purposes. This is cause for concern due to the fact that these reactor types have the ability to produce weapons-grade plutonium.

The PHWRs are refueled online, averaging 10 fuel bundles discharged per effective full power day. Daily refueling is also due to the low ^{235}U concentration of the natural uranium fuel.[7] Therefore, even under safeguard conditions, IAEA safeguards inspectors would be unable to attend every refueling of a PHWR for nuclear material accounting purposes. This poses an undeniable safeguards problem. The Indian

(220MWe) PHWR fuel reaches a burnup of about 6.3 GWd/tU during typical operation. However, the online refueling makes the reactors more susceptible to the diversion of material from the core, and this allows the potential for fuel to be intentionally burnt to a low-burnup so that weapons-grade plutonium can be produced, and then be removed from the core for purposes outside civilian energy production.

Due to the prevalent risk of the misuse of FBRs and PHWRs and the ability of these two types of reactors to produce weapons-grade plutonium, it is in the best interest of nuclear security to fully understand the detailed elemental isotopic characteristics associated with the weapons-grade plutonium that could be produced by a FBR or PHWR. A detailed understanding of these elemental isotopic characteristics would include the Pu isotopes, uranium residue isotopics, fission product traces, and elemental contaminants from chemical processes. This information would aid in nuclear forensics activities aimed at attributing intercepted pre-detonation plutonium back to its original source reactor.

I.B. Objectives

The overall objective of this thesis is to computationally predict the intrinsic physical characteristics of elemental isotopics in chemically separated weapons-grade plutonium produced from low-burnup fuel of PHWRs. These isotopic characteristics will be compared to that of a FBR to determine whether nuclear forensics methods can be used to identify the source reactor type (in the case plutonium is intercepted).

Studying the isotopic characteristics of PHWR produced plutonium and arriving at amenable isotopic ratios for the nuclear forensics development is another objective of

this thesis. The determination of isotopic concentrations in weapons-grade plutonium from a PHWR will be achieved through reactor core modeling and by performing burnup simulations.

I.C. Significance

Illicit trafficking of nuclear materials includes the unauthorized use, transport, and possession of nuclear or radioactive material. The illicit trafficking of nuclear materials poses potential dangers to the public and environment. The need to be able to combat this issue expanded in the early 1990's when cases of illicit trafficking of nuclear materials began to increase. "According to the IAEA, between 1993 and 2007, there were 1,340 confirmed incidents of illicit trafficking and unauthorized activities involving nuclear and radiological materials worldwide. Eighteen of these reported incidents involved nuclear material that could be used to produce a nuclear weapon".[8] Keep in mind these are only the incidents that the IAEA has knowledge of, and many other incidents of this type could have occurred without detection. This type of situation puts a new demand on nuclear forensics. The capabilities must not only be able to characterize the material intercepted, but trace this material back to its original unknown origin, determine the intents for its use, and identify all responsible parties. Without known information about various nuclear materials throughout the world, attribution based on a nuclear forensics analysis of the material would be difficult. Again, the knowledge of the characteristics associated with reactor-dependent plutonium is extremely important in regard to attribution in the event of intercepted Special Nuclear Matieral (SNM), especially in the case of weapons useable material.

It is important to acknowledge the possibility of an adversary attempting to disguise the material through "doping" or deliberately adding substances to alter the material's isotopic or chemical composition. However, if the isotopic characteristics of multiple materials were determined to have been manipulated in similar ways, it would lead to the conclusion that the same agent or group was involved in the smuggling and/or doping of all those materials. If the material is known to be manipulated, then it can be concluded that a knowledgeable adversary was involved in the smuggling and/or doping of the material which can aid in narrowing down possible suspects.[9] In this work the material assumed is reprocessed plutonium, and the details of the material can give clues regarding the type of reprocessing used. Therefore, although material doping for disguise is a possibility, other clues within the material may prove more important in the attribution process.

The lack of a comprehensive database is a significant roadblock in obtaining attribution due to the lack of data to compare against results obtained through nuclear forensics analysis. Even if the nuclear forensics analysis was able to identify every characteristic of the material, without anything to compare those characteristics to it is difficult to determine the exact origin of the material in question. A common database would allow for the successive exclusion method to be utilized. This method would involve altering the nuclear forensics analysis depending on the information needed to add confidence to final conlusions regarding the most likely source. This is essential for attribution based on nuclear forensics information. A few agencies in the U.S., the IAEA, and the Institute for Transuranium Elements (ITU) in conjunction with the

Bochvar Institute in Russia maintain their own database.[10] Unfortunately, these are not widely available or comprehensive enough.

The International Technical Working Group (ITWG) conducted two blind experiments at nuclear forensics capable laboratories to test the reliability of nuclear forensics results. Two different samples, which were of completely unknown origin and composition to the laboratories, were sent to the participating laboratories. The labs were able to correctly analyze the samples and determine their compositions and characteristics. The variances of answers between laboratories were within reasonable tolerances. However, the laboratories could not determine the origin of the material even though they were able to correctly and fully analyze the samples.[11] This was due to lack of a database at the laboratories' disposal to compare their results with. This displays the necessity for a comprehensive database. Nuclear forensics analysis will be inconclusive towards attribution despite its reliable results due to the lack of a comprehensive database.

Although the idea of a comprehensive international database for use in attribution after a nuclear smuggling event is useful in theory, there are a lot of roadblocks standing in the way. There may be information which is sensitive data that a country may not want to share. International policies would need to be agreed upon and established. States may refuse to cooperate in the database, and there may be attempts to include false data into the database.[10] Though states cannot be forced to participate in a database like this, it may be possible to require cooperation to this type of database by states who receive nuclear materials from the NSG to ensure that the material is properly

safeguarded and not used illicitly. Without a reliable database, attribution based on nuclear forensics analysis will be difficult, and the results from the nuclear forensics analysis may become inconclusive despite the accuracy of the results obtained during the nuclear forensics analysis. However, if a reliable comprehensive database were created, it would act as a deterrent tool due to adversaries being assured that attribution would and could be reasonably achieved.

This thesis work is significant because it aims at adding information regarding the elemental isotopic characteristics of chemically separated weapons-grade plutonium from PHWRs so that comparisons can be made if SNM is intercepted. Also, another advantage of this thesis work is that it does not rely on declarations made by individual states. The PHWR will be simulated computationally to reliably predict the elemental isotopic characteristics obtained through separated weapons-grade plutonium from low-burnup PHWR fuel. The method utilized in this thesis work could be used to simulate other reactor types in various situations to analyze the elemental isotopic characteristics of SNM in an almost unlimited number of different cases. Although much more work would need to be completed to obtain a comprehensive database for comparative purposes, this research will add an important piece to the puzzle in combating the illicit trafficking of nuclear material and associating attribution to intercepted nuclear material.

I.D. Literature Review

The analysis and safeguards of plutonium produced in power reactors is a topic of interest in nuclear security sciences. One study, performed at Oak Ridge National Laboratory by Cheatham et al., developed new techniques that can be utilized to

determine the plutonium content in a spent-fuel assembly without relying on any nuclear plant operator declarations.[12] The questions which this study was subject to answer included if the spent fuel assemblies contained differing, identifiable isotopic characteristics as a function of their burnup, cooling time, and initial enrichment; if any variations could be seen in spent-fuel isotopics from similar and dissimilar reactor power operations; and if any isotopes could be used to determine the burnup, cooling time, and initial enrichment of the spent-fuel assemblies. These authors concluded that certain isotopes, when used in combination with each other, proved to be strong indicators of initial enrichment, fuel burnup, and cooling time. This approach also determined plutonium estimates in the spent-fuel assemblies. Furthermore, Cheatham et al. concluded that identifyable characteristics of fuel can be determined by analyzing certain isotopes.

An analysis was completed by the Australian Safeguards and Non-Proliferation Office (ASNO) regarding the safeguards status of low-burnup plutonium. The ASNO argued that, "the prospect of separation of low-burnup plutonium from fast breeder reactor blankets draws attention to the position of low-burnup plutonium in the nuclear fuel cycle".[2] The ASNO declared that low-burnup plutonium would be of great interest to a diverter and therefore current safeguards practices regarding this type of material are not sufficient. The study goes on to conclude that the plutonium make-up for typical burnup levels in a PHWR are of reactor-grade, but at a low-burnup level (1.6 GWd/tU) the plutonium would be of weapons-grade.

A. Glaser reported on the neutronics calculations for some prominent natural-uranium fueled reactor types which have been historically used to produce weapons-grade plutonium in his 2009 journal publication.[13] The neutronics analysis first concludes that weapons-grade plutonium compositions can be distinguished with a high level of confidence between different reactor types, i.e., light water low-enriched uranium reactors, fast breeder reactors, and natural-uranium fueled reactors. This was concluded using the ratio of ^{238}Pu- to ^{Total}Pu. However, A. Glaser also concluded that "a nuclear forensics analysis based on predictive signatures alone, i.e., without access to actual samples, could well remain inconclusive in this case".[13] The publication expects that actual fuel samples would be able to reveal identifyable features of the material caused by various specifications like burnup or the specific production process that was used.

The "spent-fuel footprint" for both a Light-Water Reactor (LWR) and a FBR was determined through fuel composition analysis by Permana et al. in their nuclear forensics evaluation.[14] The study aimed at using these spent fuel foot-prints to estimate the origin of such material. The ratio of different actinides to ^{238}U was used for the comparison between the two reactor types. Permana et al. concluded that noticeable differences were found in the concentrations of actinides as well as the ratio evaluation of the two reactor types. Also, Permana et al. determined that the plutonium composition was greater in the FBR as opposed to the LWR due to the amount of plutonium which was initially loaded into the FBR core.

A 2010 *Journal of Nuclear Science and Technology* article, by Chiba et al., studied nuclear data for the accurate prediction of fission product concentrations.[15] Both Uranium Dioxide (UO_2) and Mixed Oxide (MOX) cells were analyzed for fission product concentrations. Both of these fuel types were assumed to be irradiated in a thermal environment. A computer code called CBG, which is under development at the Japan Atomic Energy Agency, along with a suite of isotopes including ^{95}Mo, ^{99}Tc, ^{103}Rh, ^{143}Nd, ^{145}Nd, ^{147}Sm, ^{149}Sm, ^{150}Sm, ^{152}Sm, ^{133}Cs, ^{153}Eu, and ^{155}Gd were used for the analysis. The results of this journal article stated that some fission product concentrations were similar between the UO_2 and MOX cells and large differences were observed in other cases. On case in which a large difference was observed was the ^{150}Sm isotope. The reasoning for such differences stems from the differences in the cumulative fission yields between ^{235}U and ^{239}Pu as well as possible differences in the neutron flux energy spectrum.

Other nuclear forensics studies which focus on examining the links between nuclear material and the reactors which produced it have been completed. One study in particular, by Charlton et al., developed a system using fissiogenic noble gases, namely xenon and krypton, as a verification technique for reprocessing facilities.[16] Measurements of isotopic ratios of noble fission gases were used to verify operator declarations or determine fuel parameters such as fuel type, burnup, and reactor type. Computer modeling verified the ability of isotopic ratios to distinguish between LWRs, heavy-water reactors, and breeder reactors. This system utilized the fact that noble gases are not chemically bound to the fuel and are thus released during reprocessing. Although

the isotopic ratios and database developed by Charlton et al. do not apply to the analysis of post-processed materials, the conlcusion was made that fission product signatures carry the information necesssary to infer a source reactor.

Another study was completed through a 2005 Master's Thesis by M. Scott to create a forensics methodology for attributing spent fuel used in a radiological dispersal device to a source reactor.[17] A variety of reactors were modeled with some resulting fission product isotopes selected as reactor-type monitors. Ratios of the chosen isotopes were plotted versus burnup for each reactor. M. Scott's results concluded that these isotopes could easily differentiate between a fast reactor and thermal reactor. This work; however, was focused on higher-burnup levels which are more commonly achieved in power reactors. Isotopes coming from more complex production/decay chains do not have sufficient time to be produced in low-burnup fuel material.

In yet another nuclear forensics study, plutonium isotopics were analyzed and used for the purposes of origin determination from plutonium seized in the illicit trafficking of nuclear material.[18] M. Wallenius et al. completed this study by using the code, ORIGEN2, to calculate the plutonium composition for multiple reactors, as well as a thermal ionization mass spectrometer to measure the plutonium isotopic compositions of five plutonium samples. The source reactor of each sample was then concluded by comparing the measured and computationally calculated isotopic compositions. This study raised a number of concerns, though, with regards to the isotopics and computer modeling. The isotopic analyses consisted of plutonium and actinides only, with no investigation of contaminant fission products. The isotope generation and depletion

code, ORIGEN2, is a zero-dimensional model giving the composition averaged over the enitre reactor core. This could become problematic with a reactor type like the FBR, whose core consists of very different fuel and blanket regions. Additionally, irradiation times were considered to be continuous and no cooling time corrections were made to the material which may not be realistic in all cases. Burnup levels obtained for the computational models were equivalent to typical burnup for each reactor with the exception of the FBR. Here, the FBR blanket material had a burnup of 20 GWd/tU, which is about twenty times higher than typical FBRs.

Based on these studies, it is evident that work regarding the development of plutonium signatures or fission product signatures which attribute nuclear material to a source reactor has been completed. Most of the research completed, however, has been focused on reactor spent fuel irradiated to typical, higher-burnup levels. Lacking in open literature, are investigations of signatures in weapons-grade material as a result of low-burnup fuel from reactor misuse or a FBR blanket. Also, since most research was completed using spent fuel, the idea of characterizing reprocessed fuel is also a characteristic aspect to the current research presented in this thesis. The use of plutonium and fission product isotopes to develop isotopic characteristic ratios in weapons-grade plutonium capable of suggesting a source reactor is a different approach which will improve the state of the art by adding analysis of reprocessed material from a low-burnup scenario.

II. METHODOLOGY

II.A. Theory

The most commonly employed technique for separating plutonium from uranium and fission products in used nuclear fuel is the Plutonium Uranium Extraction Process (PUREX).[19] Using the PUREX process, decontamination factors* of $\geq 10^6$ have been achieved for the reduction of fission products in separated plutonium; however, a measurable contaminant of fission products will remain.[20] This is due to the non-ideal chemical process presented by the PUREX process. Contaminant concentrations in separated plutonium are also anticipated to be varying between reactor types based on their specific neutron energy spectra and fission yield curve. A detailed plutonium characterization for nuclear forensics will include fission product contaminant estimates.

II.A.1. Neutron Energy Spectra

Differences in fission product and actinide content in used fuel from each reactor type are anticipated due to differences in the neutron energy spectra of the different reactor types. The neutron energy spectra for both the PHWR and the FBR were produced using data from the computational simulations of each reactor. Figure 2 shows the neutron energy spectrum for both the PHWR and the FBR. The FBR spectrum was acquired through private communications with Jeremy Osborn, at Texas A&M University.

* "The degree of purification achieved by a process is denoted by decontamination factors (DFs), defined as the ratio of a stated impurity to desired component in the feed divided by the equivalent ratio in the product; values of 10^6-10^8 are typically needed and demand a very specific and efficient separation process."[27]

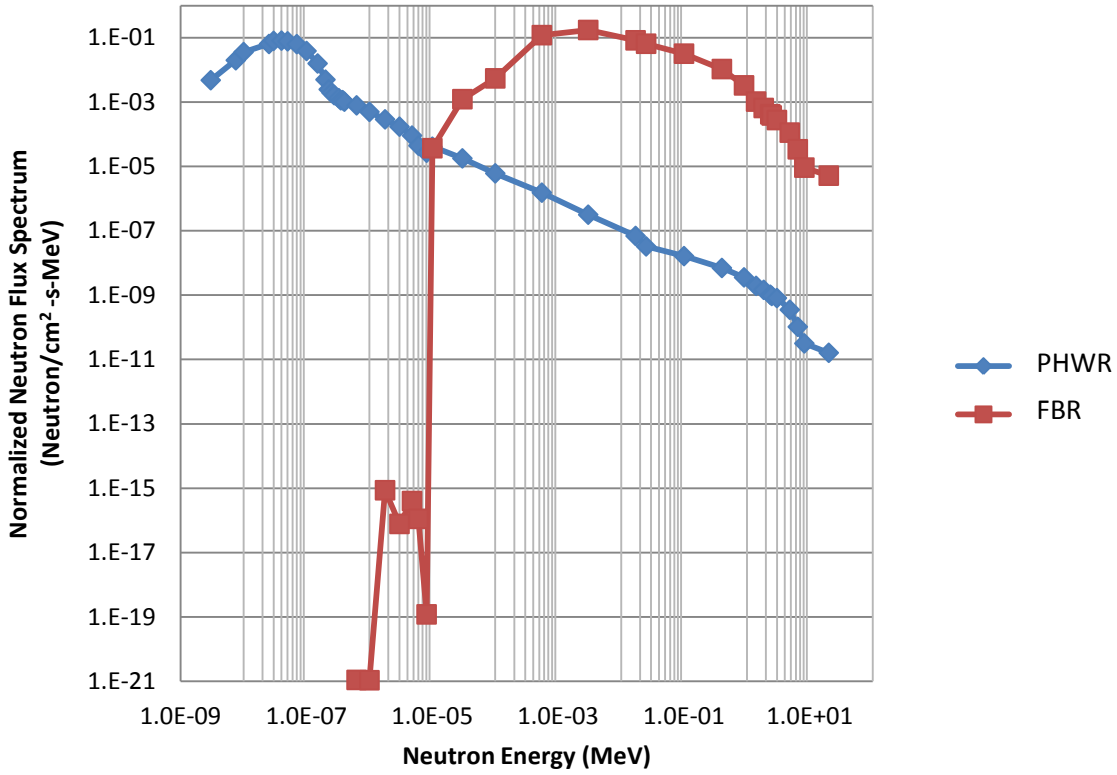


Fig. 2. Neutron energy spectrum for PHWR and FBR as calculated by MCNPX.

Noticeable differences can be identified between the FBR and PHWR neutron energy spectra. It is to be noted from Fig.2 that the PHWR neutron energy spectrum is dominated by the thermal energy region (around 1E-8 MeV). Although the PHWR has a small amount of peaking in the fast region, the thermal peaking is much more dominant if the spectrum is normalized per unit energy. The FBR is dominated by the fast energy region (around 100^{+} keV).[21] The thermal versus fast spectra will allow for differences in the plutonium vector as well as in the fission product content, actinide content and other

contaminants in the irradiated fuel from each reactor type. This leads to anticipated results confirming that the intrinsic physical characteristics of the elemental isotopics in chemically-separated weapons-grade plutonium from irradiated PHWR fuel will indeed be differentiable from other reactor types.

II.A.2. Fission Yield Curve

Similar to the plutonium composition, fission product inventories in the discharged fuel have a large dependency on parameters such as fuel burnup, neutron energy spectrum of the reactor, and the time after irradiation. The fission product yields are a function of the fissioning isotope and the energy of the neutron causing fission. Figure 3 displays the fission product yield for the thermal fission of ^{235}U, and for the fast fission of ^{238}U and ^{239}Pu.[22] Fissions in a PHWR are dominated by thermal fissions of ^{235}U. Fissions in the FBR radial blanket are shared between the fast fission of ^{238}U and ^{239}Pu. Note, the energy for the fast fission yields in Fig. 3 is at a neutron energy of 500 keV, whereas the energy of the dominant neutrons in the FBR is from 100 to 250 keV.

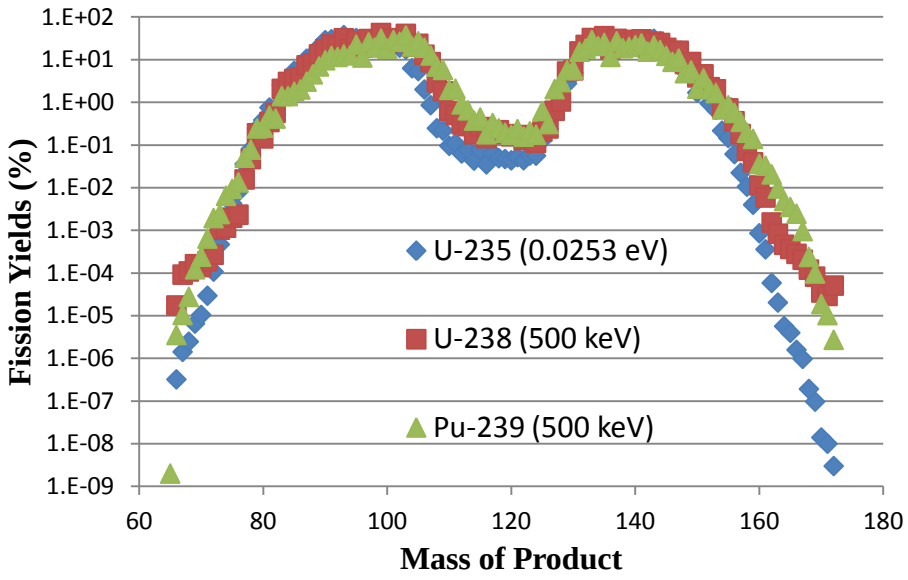


Fig. 3. Cumulative fission yield curves for various isotopes and neutron energies.

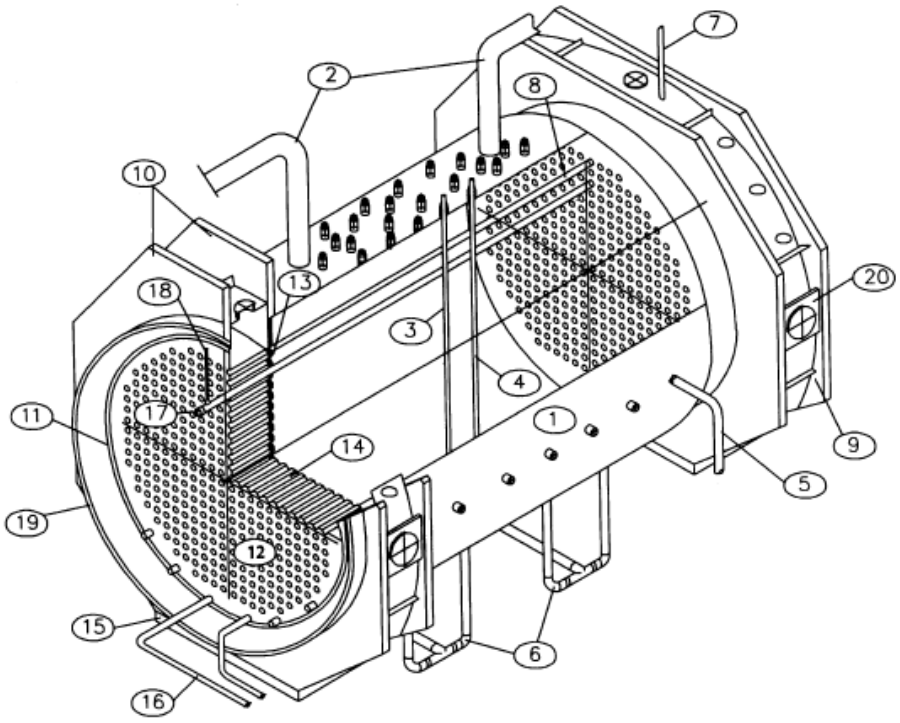
Some differences can be seen between the thermal and fast reactor fission yields, especially at high product masses. These curves along with the neutron energy spectrum show anticipated variations in the fission product vectors between the two reactor types. Hence, analyses of fission product inventories, a small portion of which will be contaminant in the separated plutonium, can comprise part of a nuclear forensics technique capable of attributing plutonium to a source reactor.

II.B. Indian 220 MWe Pressurized Heavy Water Reactor

The Indian 220 MWe PHWR[23] was the reactor of interest in this thesis work. India chose to pursue PHWR's based on their long-term nuclear goals, resource availability, and infrastructure. The PHWRs serve as the first stage of the Indian three

stage nuclear power production program to create a self-reliant India. The PHWR is attractive for this stage due to many factors. Its use of natural uranium eliminates the need to develop or operate fuel enrichment facilities. The heavy-water moderation allows for low requirements of natural uranium in the initial core loading and subsequent refueling. The sophistication of the PHWR is within the capability of India's nuclear industry. Also, heavy-water production technology is available in India.[23] The main features of the Indian 220 MWe PHWR full core are shown in Fig. 4.[23]

The channels of the reactor, represented by number 8, are completely encased by the outer boundary of the reactor or 'Calandria shell' which is represented by number 1. The main design features of the Indian 220 MWe PHWR include natural uranium dioxide fuel, heavy-water moderation, and heavy water at a high temperature and pressure in a separate circuit for heat removal purposes. The moderator heavy water is contained in the low-pressure horizontal reactor vessel or 'Calandria'. This heavy water is near ambient pressure and temperature. The high pressure and temperature coolant heavy water circulates around the fuel pins located inside the individual pressure tubes (fuel channels). Inside each pressure tube, 19 natural uranium dioxide fuel pins are arranged in three concentric rings. These 19 fuel pins make up a single fuel bundle, and 12 fuel bundles are aligned horizontally to create a single fuel channel.[23] As can be seen in Fig. 4, many channels, represented by the number 8, are arranged to make up the full core of the Indian 220 MWe PHWR.



1.	CALANDRIA SHELL	2.	OVER PRESSURE RELIEF DEVICE
3.	SHUT DOWN SYSTEM #1	4.	SHUT DOWN SYSTEM #1
5.	MODERATOR INLET	6.	MODERATOR OUTLET
7.	VENT PIPE	8.	COOLANT CHANNEL ASSEMBLY
9.	END SHIELD	10.	END SHIELD SUPPORT STRUCTURE ASS'Y
11.	MAIN SHELL ASS'Y	12.	TUBE SHEET F/M SIDE
13.	TUBE SHEET CAL SIDE	14.	LATTICE TUBE
15.	END SHIELD SUPPORT PLATE	16.	END SHIELD COOLING INLET PIPES
17.	END FITTING ASS'Y	18.	FEEDER PIPES
19.	OUTER SHELL	20.	SUPPORT LUG

Fig. 4. Description of Indian 220 MWe PHWR full core.[23]

Another important feature of the Indian 220 MWe PHWR is the online refueling capabilities. During the online refueling of the reactor, fuel bundles are replaced with fresh fuel bundles. A sketch of a single bundle which is replaced during a refueling operation is shown in Fig. 5.[23] To perform the refueling operation, two remotely

controlled fueling machines are connected to each end of the fuel channel which is being refueled. Fresh fuel bundles are collected by one of the refueling machines through the new fuel port. Then, while fresh fuel bundles are inserted into the fuel channel from one refueling machine, spent fuel bundles are collected by the refueling machine connected to the opposite side of the fuel channel. On average, 8 fuel bundles are replaced with fresh fuel bundles during the refueling of a single channel, and 10 fuel bundles are refueled per effective full power day of operation.[7] These fueling mechanisms can either load or receive fuel at any given time. After loading the fresh fuel bundles, the fueling machine containing the spent fuel bundles releases these bundles through the discharge port. These irradiated fuel bundles are then transported while under water to the Spent Fuel Storage Bay where the long term-storage of spent fuel occurs.[23]

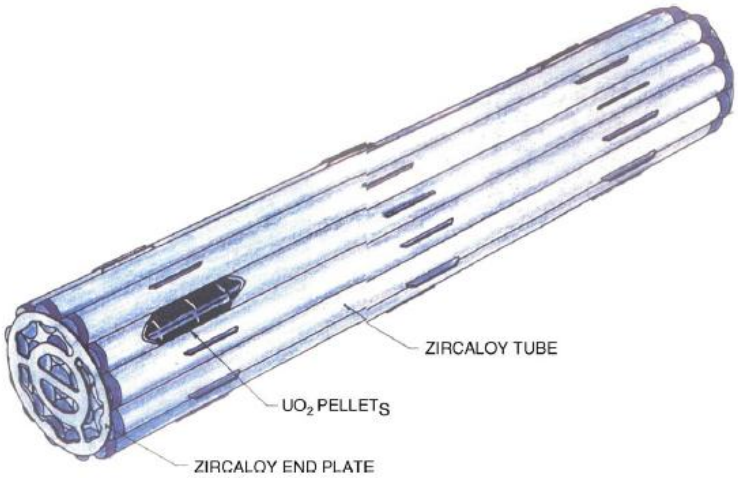


Fig. 5. Sketch of a single 19 fuel pin bundle.[23]

More specific parameters of the Indian 220 MWe PHWR which were followed during computational modeling, including power, material, and sizing are displayed in Table III.[23] There are also two types of shutdown systems utilized in the PHWR. The first system consists of mechanical shutoff rods, and the second system consists of empty tubes located in the core region so that various chemical poisons can be inserted if necessary. These shutdown systems were not used in the computational modeling of the core because this work was only concerned with full power day operation to achieve the desired burnup.

Table III

Design Information for the Indian 220 MWe PHWR[23]

Characteristic	**Design Data**
Rated output thermal	746 MWt
Rated output electrical	220 MWe
Average fuel discharge	6.7 GWd/tU
Moderator and Reflector	Heavy Water
Heavy Water Quantity	136000 kg
Coolant	Heavy Water
Heavy Water Quantity	100000 kg
Fuel	Natural UO_2
Cell array	Square
Lattice pitch	22.9 cm
Fuel form	Pellet
Fuel bundles per channel	12 (10.1 active core)
Fuel elements per bundle	19
Bundles in reactor	3672
Cladding material	Zircaloy-2
Cladding thickness	0.41 mm

TABLE III Continued

Characteristic	Design Data
Length of bundle	495 mm
Outter diameter of bundle	81.7 mm
Weight of bundle	16.4 kg
Weight of U per bundle	13.4 kg
Active Core Length	500 cm

II.C. Monte Carlo N-Particle Code

For the thesis work presented here, a code called Monte Carlo N-Particle (MCNP) was used. The manual describes MCNP as "a general-purpose, continuous-energy, generalized-geometry, time-dependent, coupled neutron/photon/electron Monte Carlo transport code".[24] The user creates an input file which contains information regarding geometry specifications, material descriptions, neutron interaction cross-section probabilities, location and characteristics of neutron/photon/electron source, type of output information desired, and any variance reduction techniques to be applied for simulation efficiency improvement.[24]

MCNP is based on the Monte Carlo method. In general, this method is used to theoretically duplicate a statistical process such as various interactions of nuclear particles with matter. This is completed by simulating individual probabilistic events of a certain process. The probability distributions associated with these events are then statistically sampled to describe the overall phenomenon. The statistical sampling

process is based on a random number system. Each particle from the specified source is followed from its birth to its death in a system. Transport data is used along with randomly sampled probability distributions to determine each event in a particles 'life'.[24] An example of a particle's life in an MCNP simulation is shown in Fig. 6.[24]

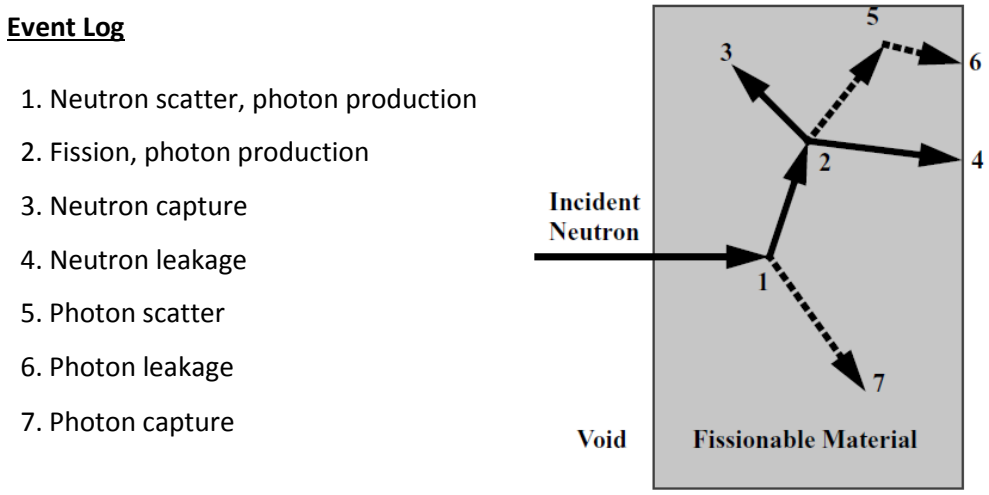


Fig 6. Example particle life history in an MCNP simulation.[24]

Figure 6 displays the random history of a neutron incident on a slab of fissionable material as it could be simulated in MCNP. Random numbers are generated through the rules of mathematics and a random number generator. These random numbers are then used to evaluate probability distributions to determine if an interaction

takes place, what type of interaction takes place, and where an interaction takes place. The probability distributions are based on the rules of physics, transport data, and materials involved in the process.

At event 1, the incident neutron scatters and a photon is released. The direction of the scattering neutron is selected randomly through the scattering probability distribution, and the photon is stored in a particle bank for later analysis. At event 2, fission occurs, releasing two neutrons and a photon. One neutron continues to be tracked while the other two particles are banked for later analysis. At event 3, the neutron being tracked by the code is captured and its 'death' has now occurred. MCNP will now retrieve a banked particle to track. The last particle stored in the bank will be the first particle taken out for tracking. Therefore, the second neutron created in the fission event will be tracked until its death and so forth until all particles have been randomly sampled until their death in the system. As more of these particle histories are tracked, neutron and photon distributions become better known, and quantities of interest are tallied.[24]

This Monte Carlo method is particularly useful for complex situations that cannot be sufficiently modeled using a deterministic method computer code. The deterministic method solves the transport equation for the average particle behavior. The Monte Carlo method, however, solves the transport equation by simulating individual particles, and then inferring the average particle behavior in the system using the central limit theorem and data collected from the simulated particles. The deterministic method also gives complete information throughout the phase space of the specified system. The Monte Carlo method only gives information where the user requests. This can cut down on

computational time when only specific pieces of information are necessary. The way each method tracks particles is also different. The deterministic method divides its phase space into small boxes and tracks particles from box to box. In contrast, the Monte Carlo method tracks particles from event to event in space and time. Without the use of phase space boxes, no averaging approximations are required in space, energy, or time.[24] Based on these differences, a Monte Carlo method was ideal for use in this thesis work.

II.D. CINDER90 and ORIGEN 2.2 Burnup/Depletion Codes

To complete the burnup portion of the simulation, CINDER90[25] was utilized. CINDER90 is a computer code, which handles isotope buildup and depletion calculations and is built into MCNPX. One of the benefits of having CINDER90 built into the MCNPX code is that only a single input is necessary to complete both the transport and depletion/burnup calculations. To utilize CINDER90 through MCNPX, the BURN feature is introduced into the input file.[25] MCNPX then takes the burn criteria from the BURN instruction along with the 63-group neutron fluxes and provides the information to CINDER90. That neutron flux data is then matched with 63-group cross-sections by CINDER90 to produce reaction rates, which then allows CINDER90 to provide MCNPX with the depletion data and with updated isotopic compositions. The updated isotopic compositions will give an estimate of the plutonium, transuranics, uranium, and fission product signatures in the depleted fuel from the PHWR.

CINDER90 is a FORTRAN based computer program which is coupled with extensive data libraries used in the calculations of nuclide inventory at various time steps. The computer code CINDER was originally developed in 1960 by Bettis Atomic

Power Laboratory (BAPL). Decay and energy integrated reaction rate probabilities as well as fission yield information is utilized by CINDER to calculate nuclide buildup and depletion.[26]

The computation process is based on the Markov Chain Method. Instead of using preexisting transmutation path information, CINDER90 uses its available nuclear data to follow the path of each transmutation of each nuclide until it reaches a point of insignificance. Linear chains are created for each nuclides transmutation path. The partial nuclide density found from each chain is summed to determine the total nuclide inventory. Because these linear chains are utilized, the nuclide inventory is only coupled to the preceding elements in the sequence where all parameters are assumed known. Therefore, the simplified differential equation,

$$\frac{dN_i}{dt} = \bar{y}_i + N_{i-1}(t)\gamma_{i-1} - N_i(t)\beta_i \,, \qquad (2)$$

can be used to represent the time-dependent change in any nuclide. [25,26] Where $\frac{dN_i}{dt}$ is the time dependent change in nuclide i, $\bar{y}_i$ is the production of nuclide i via an external source, β_i is the total transmutation probability of nuclide i, N_{i-1} is the time-dependent atom density of nuclide i-1, γ_{i-1} is the transmutation (absorption or decay) probability of forming nuclide N_i, and N_i is the time-dependant atom density of nuclide i. The solution for any such given linear sequence is

$$N_n(t) = \prod_{k=1}^{n-1}\gamma_k \left\{\bar{y}_m \left[\frac{1}{\prod_{l=1}^{n}\beta_l} - \sum_{j=1}^{n}\frac{e^{-\beta_j t}}{\prod_{i=1,\neq j}^{n}(\beta_i-\beta_j)}\right] + N_1^0 \sum_{j=1}^{n}\frac{e^{-\beta_j t}}{\prod_{i=1,\neq j}^{n}(\beta_i-\beta_j)}\right\}, \qquad (3)$$

where the paramters are the same as previously described.[25, 26]

The accuracy of CINDER90 will be dependent on the data used to calculate the time-dependent nuclide densities. Since CINDER90 by itself is a zero-dimensional code, approximations are required so that the code can solve for flux values which are then used to compute reaction rates. These approximations would lead to inaccurate reaction rate calculations unless CINDER90 is linked to a steady state rate calculator, like MCNP, in order to correct for the spatial behavior of the system.[26]

Other codes also posses the capability of completing burnup calculations. The Oak Ridge National Laboratory (ORNL) based code, ORIGEN 2.2, is a versatile point-depletion and radioactive-decay code for the use of simulating nuclear fuel cycles and calculating the nuclide compositions and characteristics of materials within the nuclear fuel cycle. It was primarily intended for use in generating spent fuel and waste characteristics. ORIGEN 2.2 uses decay, cross section, fission product yield, and photon emission data bases connected to a user specified reactor type to produce output information.[27] ORIGEN 2.2 is based on the Matrix Exponential Method. The basic equation which ORIGEN must solve, is the rate at which the amount of nuclide *i* changes as a function of time. This homogenous first order ordinary differential equation is shown by

$$\frac{dX_i}{dt} = \sum_{j=1}^{N} l_{ij}\lambda_j X_j + \Phi \sum_{k=1}^{N} f_{ik}\sigma_k X_k - (\lambda_i + \Phi\sigma_i + r_i)X_i + F_i, \quad i = 1, \ldots, N \ . \quad (4)$$

Here, X_i is the atom density of nuclide i, N is the number of nuclides, l_{ij} is the fraction of radioactive disintegration by other nuclides which leads to formation of species i, λ_i is the radioactive decay constant, Φ is the position and energy averaged neutron flux, f_{ik} is the fraction of neutron absorption by other nuclides which leads to formation of species

i, σ_k is the spectrum averaged neutron absorption cross section of nuclide k, r_i is the continuous removal rate of nuclide i from the system, and F_i is the continuous feed rate of nuclide i.[27]

Therefore, there will be a set of N first order ordinary differential equations corresponding to the N nuclides being considered in the system. The system of equations being solved can be denoted by

$$\dot{Z} = AZ, \tag{5}$$

where $\dot{Z}$ is the time derivative of the nuclide concentrations (a column vector), A is the transition matrix containing the transformation rates (a 1700 X 1700 matrix largely filled with zeros), and Z is the nuclide concentrations (a column vector).[27] Equation (5) has the solution

$$Z(t) = \exp(At)\, Z(0)\ , \tag{6}$$

where t is the time at the end of a specified time step, and all other parameters are the same as previously described.[27]

The maximum number of nuclides which can be considered in ORIGEN is 1700, and the average number of parents per nuclide is less than 12. This will lead to about 99 % zero values in a 1700 X 1700 matrix. To avoid space consumption by zero values, ORIGEN employs indexing techniques that only store the nonzero elements of the matrix. These transformation rates are then permanently stored in a matrix called the transition matrix. The system of simultaneous differential equations represented by coefficients in the transition matrix along with user specified input material, power level, and time are then used to complete irradiation and decay calculations.[27]

Nuclides are broken into 3 categories to complete the irradiation and decay calculations because of the vast differences in nuclide half-lives. First, a set of asymptotic solutions are implemented to handle the short-lived nuclides. These nuclides must have half-lives of less than 14.4 % of the time step specified by the user. Hence, these nuclides will reach an equilibrium level during the time step and a simple asymptotic solution is accurate in calculating their concentration at the end of the time step. Second, the long-lived nuclides irradiation and decay calculations are completed. The matrix exponential method is used, and concentrations of each nuclide at time t are generated. The degree of accuracy of this result relies on the number of terms incorporated into the method. Last, short-lived nuclides with long-lived parents are dealt with. Another set of asymptotic solutions to the differential equations is used to calculate the irradiation and decay information for this limited set of nuclides. A Gauss-Seidel successive substitution algorithm is employed to solve these asymptotic solutions. Now, the concentrations for each nuclide at the end of the specified time step have been calculated and stored for output or use as the initial concentration for the successive time step.[27]

For the purposes of this thesis work, CINDER90 was determined to be the optimal burnup/depletion code. ORIGEN 2.2 has a nuclide decay and interaction probability library inclusive of 1700 nuclides while CINDER90 has a library inclusive of 3456 nuclides.[26] Since this thesis work analyzed trace isotopic characteristics within the Pu vector, more traceable nuclides were essential for a detailed analysis of fission product contaminants in plutonium. The Markov Chain Method is more capable of

storing concentrations of a complete set of fission products and isotopes. Also, since CINDER90 is coupled with MCNPX, other reactor information outside of end material concentrations was available in the output. This proved useful in this thesis work for ensuring the neutron multiplication factor, k_{eff}, was above 1.0 during simulations and for flux profiling. Last, ORIGEN 2.2 allows the user to input a type of reactor to burn instead of requiring the user to build the reactor themselves. This simplification was not ideal for this thesis work, because the online refueling which was modeled in MCNPX could not be reproduced in ORIGEN 2.2. Another option would have been the use of MONTEBURNS[28], which is a code that links MCNP to ORIGEN; however, this code also has the limitation of 1700 nuclides as compared to 3456 in CINDER90.

Initially, the entire core of the PHWR was modeled computationally using MCNPX-2.7. The PHWR model was based on the Indian-19 220 MWe PHWR. A single fuel bundle within the core was chosen for the isotopic analysis. This channel was exempt from refueling and was located in the center of the PHWR core as to achieve the desired burnup (1 GWd/tU and 2 GWd/tU) in the fastest time. Once this targeted bundle reached the desired burnup, the simulation of the PHWR core ceased and analysis could be completed.

Also, a single bundle of fuel with reflective boundary conditions on all sides was modeled computationally using MCNPX-2.7. This bundle was modeled as to mimic the PHWR core yet be more simplistic as to decrease simulation time requirements. After comparing the results from the targeted bundle in the PHWR core model and the single bundle with reflective boundary conditions model, it was determined that the model of a

single bundle with reflective boundary conditions was sufficient for the isotopic analysis. The single bundle with reflective boundary conditions was also axially and radially analyzed to determine the number of regions required. A single axial and a single radial region were determined to be sufficient for the single bundle model.

III. COMPUTATIONAL MODELING

III.A. Full Core Computational Modeling

The entire core of the PHWR was modeled computationally using MCNPX-2.7, and the input deck can be seen in Appendix A. The PHWR model was based on the Indian 220 MWe PHWR. As previously stated, this reactor type utilizes 19 fuel pins, each with a 0.72 cm radius, arranged in 3 concentric rings to create a fuel bundle. Each fuel bundle has a total length of 49.0 cm. These fuel bundles are then lined horizontally to create a single coolant channel consisting of 12 fuel bundles. The channels are then arranged as shown in Fig. 7 to create the core configuration. There are 306 coolant channels in the full core of the PHWR. However, of the 12 fuel bundles in the coolant channel, only 10.1 fuel bundles are within the active core region as shown in Fig. 8.

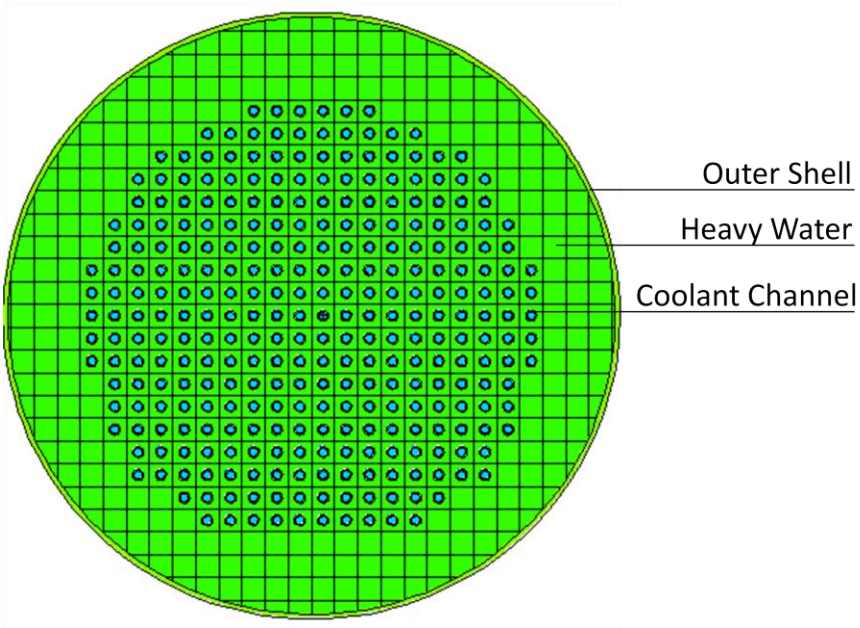


Fig. 7. The full core model of the PHWR.

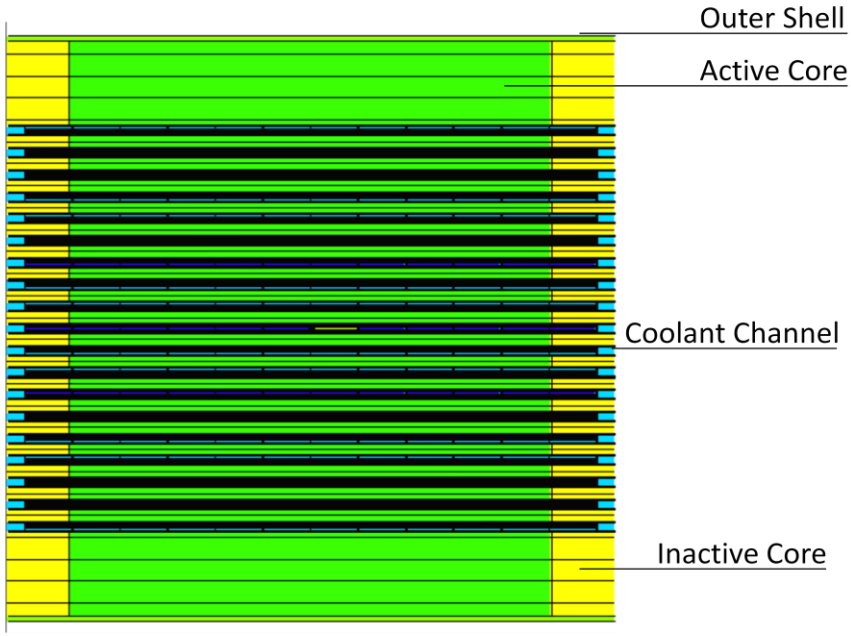


Fig. 8. The active core region of the PHWR.

Due to the utilization of natural uranium fuel in the PHWR core, refueling occurs often. Averages of 10 bundles are refueled per effective full power day.[29] The refueling of the PHWR is completed on-line and the reactor is not shut down when the refueling occurs. During the refueling, certain channels are chosen for refueling and bundles within the channel are reshuffled. Four bundles are reshuffled and remain in the channel once the refueling is complete, while the remaining 8 bundles are removed and replaced with fresh fuel bundles.[23] This process is shown in Fig. 9. Bundles 1-4 are reshuffled and remain in the channel once the refueling is complete while bundles 5-12 are removed and fresh fuel bundles are added to occupy the initial 8 bundle locations within the channel.

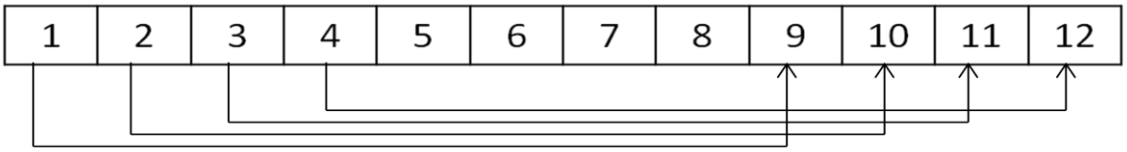


Fig. 9. A representation of the refueling scheme of a single fuel channel.

For the first 5 effective full power days, a single channel was refueled each day to ensure the neutron multiplication factor, k_{eff}, remained above 1.0. After observing very little change in the k_{eff} value in those 5 effective full power days, larger time steps

were chosen between refueling. Next, a single channel was refueled after 2 effective full power days, 4 effective full power days, and another 4 effective full power days. A total of 8 fuel channels were refueled and a k_{eff} value greater than 1.0 was maintained before the desired 1 GWd/tU burnup was achieved. The k_{eff} value did not decrease noticeably in the computational simulation due to the low desired burnup and the initial core being loaded with fresh fuel. In the case of a PHWR at typical burnups, about one fuel channel would need to be refueled per effective full power day to maintain a k_{eff} value greater than 1.0. A single targeted bundle in the core was used for analysis and a 60 day decay period was also included so that appropriate comparisons could be made with the simulated FBR isotopic analysis.

III.B. Single Bundle Computational Modeling

As well as modeling the entire core of the PHWR, a single fuel bundle was modeled, as shown in Fig. 10, with reflective boundary conditions on all sides to mimic an infinite lattice of the PHWR core. The input deck for the PHWR single fuel bundle model can be seen in Appendix B. The single bundle model was also simulated using MCNPX-2.7 until a desired burnup of 1 GWd/tU was achieved. Since this model was of a single bundle and reflective boundary conditions were applied, no simulated refueling was necessary during the burnup of the single bundle computational model.

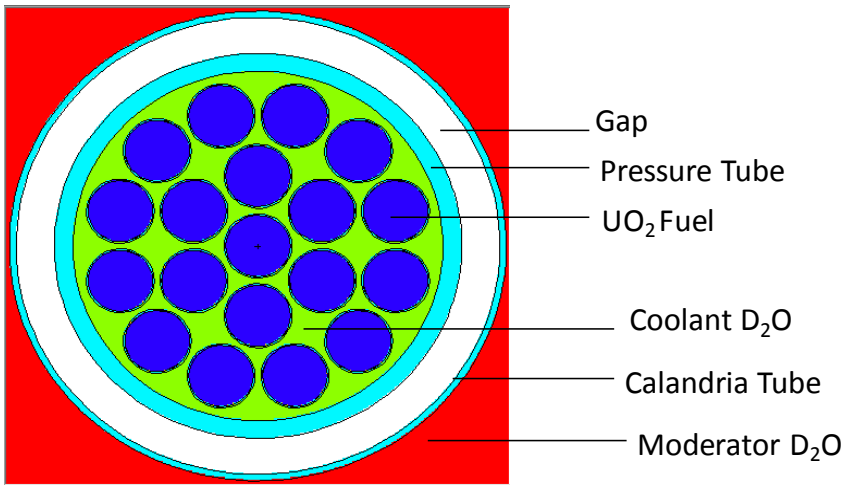


Fig. 10. A single fuel bundle.

The isotopic results from this single bundle simulation were compared with the isotopic results from the targeted bundle in the PHWR full core simulation. The percent differences in isotopics were normalized per unit burnup and compared in order to verify that the single bundle computational model was sufficient in mimicking the targeted bundle in the full core computational model. The percent differences are shown in Table IV.

TABLE IV

Isotopic Percent Difference Between Core and Bundle Computational Models

Isotope	Targeted Bundle (g/(GWd/tU))	Single Bundle (g/(GWd/tU))	Percent Difference (%)
^{137}Cs	0.5026	0.5046	0.4002
^{125}Sb	0.0019	0.0019	0.5079
^{144}Ce	0.4701	0.4719	0.3949
^{155}Eu	0.0032	0.0033	1.0102
^{85}Rb	0.0339	0.0341	0.5678
^{90}Sr	0.3029	0.3042	0.3951
^{147}Pm	0.0059	0.0060	0.8431
^{150}Sm	0.0028	0.0027	1.4517
^{239}Pu	1.6344	1.6515	1.0331
^{240}Pu	0.0090	0.0088	1.8693
^{tot}Pu	1.6434	1.6603	1.0176
^{129}I	0.0240	0.0242	0.7665
^{148}Nd	0.1495	0.1502	0.4608
^{tot}U	319709.7	329165.4	2.8726

After comparing the results from the targeted bundle in the full core computational model and the single bundle computational model with reflective boundary conditions, it was determined that the model of a single bundle with reflective boundary conditions was sufficient for the isotopic analysis. The percent differences in the isotopics between the two models were determined after normalizing concentrations from one effective full power day of burnup. After the one effective full power day of

burnup, the targeted bundle in the core model had undergone 4.106E-02 GWd/tU of burnup and the bundle model had undergone 4.218E-02 GWd/tU of burnup. The difference in burnup between the two models was 2.728 %. This difference in final burnup after one effective full power day of simulation was taken into account by dividing the concentrations of the isotopes by the appropriate model's burnup to obtain normalized concentrations per unit burnup. The isotopic concentration percent differences were all less than 3%, and most errors being less than 1 %. All other isotopes not included in this comparison were anticipated to have similar normalized percent difference values based on the consistency in normalized percent differences from the isotopes studied. The model of a single fuel bundle with reflective boundary conditions was chosen due to its simplicity and decreased computational requirements as compared to the full core computational model. The single bundle computational model with reflective boundary conditions was utilized for all further simulations in this thesis.

III.B.1. Radial Bundle Splitting

Within any given cylindrical fuel pin, the fission rate and neutron spectrum are known to vary between the surface of the fuel pin and the center of the fuel pin. Central portions of fuel pin at an arbitrary burnup can have different isotopic concentrations from the thin surface layers of the fuel pin.[30] Therefore, it is important to determine the appropriate number of radial fuel regions per pin in the single bundle computational model since MCNPX-2.7 averages the isotopics over the user specified region.

A study was performed at Los Alamos National Laboratory to determine the proper distribution of radial regions throughout a fuel pin. A linear separation, quadratic

separation, and an exponential separation of a fuel pin were studied. It was concluded that an exponential distribution was most sufficient due to its attention to low-energy neutrons as they travel into the fuel region.[30] Since the PHWR is dominant in the thermal region, the exponential distribution,

$$r(i) = R_{fo}\left[\frac{1-\exp(-\Sigma_a i)}{1-\exp(-\Sigma_a N_r)}\right] \quad \text{for } i = 1, 2, 3, \ldots, N_r\,, \tag{7}$$

was chosen to separate the single bundle computational model into various radial regions.[30] Where r(i) represents the outer radius of fuel region i, R_{fo} represents the fuel pin outer radius, N_r represents the total number of desired radial fuel regions, and Σ_a represents the one-group macroscopic absorption cross section.

The total number of desired radial fuel regions was chosen as 1, 3, 5, and 7 as shown in Fig. 11. More radial fuel regions would be necessary if change beyond statistical errors was still seen with 7 radial fuel regions. To determine the appropriate number of radial fuel pin regions, the concentration of various isotopes from each radial section were summed and compared to the concentration of that particular isotope in the single radial region model. If those concentrations were not equivalent within a reasonable error, multiple radial fuel pin regions would be necessary. Once change in isotopic concentrations within a reasonable error ceased, the amount of radial fuel regions would be determined sufficient. If those concentrations were equivalent within a reasonable error, less radial fuel pin regions would be sufficient. In the case of the single bundle model used for this thesis work, each number of radial fuel pin regions (3 regions, 5 regions, and 7 regions) tested to have less than a 0.5 % difference in isotopic concentrations to the single region fuel pin computational model. Therefore,

averaging the isotopics over a single region was sufficient, and throughout this thesis work a single radial fuel pin region was modeled in all computational simulations.

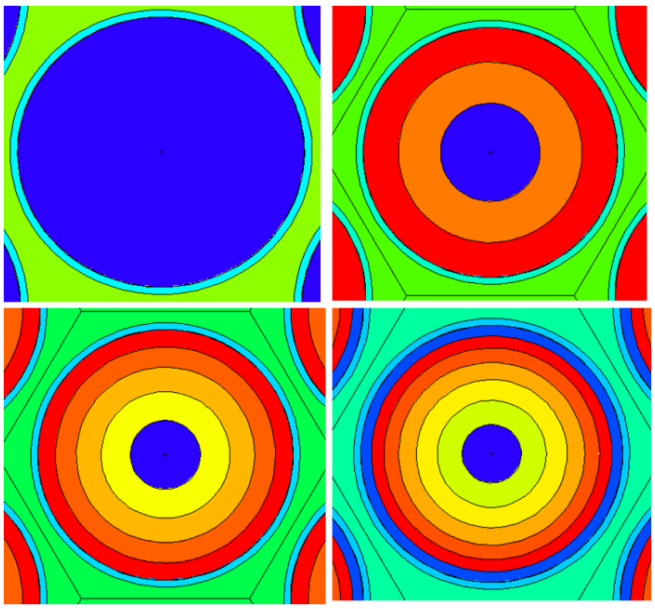


Fig. 11. The 1 region (top left), 3 region (top right), 5 region (bottom left), and 7 region (bottom right) radial split single bundle model fuel pin.

III.B.2. Axial Bundle Splitting

After analyzing the appropriate number of radial fuel regions necessary for a single fuel pin, the appropriate number of axial fuel regions necessary for a single fuel pin was analyzed as well. The power distribution along the axial portion of the fuel pin is known to vary. The shape is relatively flat along the central portion of the fuel pin, and

tends to drop off close to the ends of the fuel pin.[26] Again, since MCNPX-2.7 averages isotopics over the user specified area, it is important to determine the appropriate number of axial fuel pin regions required for accurate isotopic results.

Continuing to follow the study completed at Los Alamos National Laboratory, the simple linear distribution,

$$z(j) = \frac{H}{2}\frac{j}{N_z} \text{ for } j = 0, 1, 2, \ldots., N_z, \quad (8)$$

was chosen for the axial splitting of the single bundle fuel pins.[30] Where z(j) represents the upper boundary of axial fuel region j, H represents the total fuel pin height, and N_z represents the total number of axial fuel pin regions chosen.

An exponential distribution where many more fuel regions would be created at the ends of the fuel pin as opposed to the center could have also been used for the axial splitting of the single bundle model fuel pins. However, it was determined that the linear distribution method was sufficient for the purposes of axial splitting of the single bundle model fuel pins for this thesis work.

The total number of desired axial fuel pin regions was chosen as 1, 3, 5, and 7 axial regions as shown in Fig. 12. As in the radial splitting analysis, to determine the appropriate number of axial fuel pin regions, the concentration of various isotopes from each axial region were summed and compared to the concentration of that particular isotope in the single axial region model. If those concentrations were not equivalent within reasonable errors, more axial fuel pin regions would be necessary until change in isotopic concentrations between successive increasing numbers of axial regions ceased. If those concentrations were equivalent within reasonable errors, less axial fuel pin

regions would be sufficient. In the case of the single bundle model used for this thesis work, each number of axial fuel pin regions (3 regions, 5 regions, and 7 regions) tested to have less than a 0.5 % difference in isotopic concentrations as compared to the single axial fuel pin computational model. Therefore, averaging the isotopics over a single axial region was also sufficient, and throughout this thesis work a single axial fuel pin region was modeled in the computational simulations.

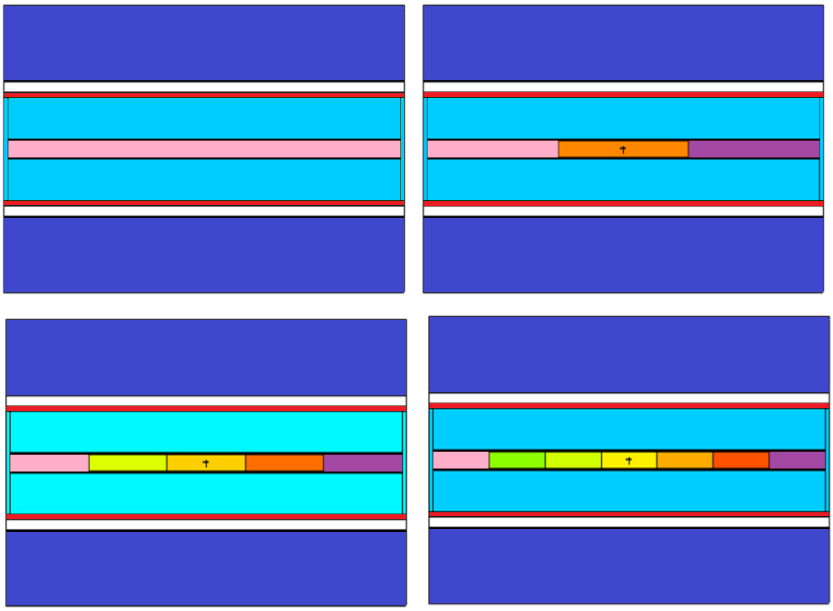


Fig. 12. The 1 region (top left), 3 region (top right), 5 region (bottom left), and 7 region (bottom right) axial split single bundle model fuel pin.

III.C. Computational Model Verification

To ensure the full core and single bundle computational models were void of errors, verification checks were conducted. First, the concentrations of the various isotopes of plutonium in both the full core and single bundle computational model were plotted as a function of burnup. These plots were compared against Fig. 1 which displays typical plutonium buildup in a PWR. Although Fig. 1 displays plutonium buildup up to 40 MWd/kg, comparisons can still be made at the lower-burnup levels for verification of the computational models. The percent mass of various isotopes in the total plutonium versus burnup levels are shown for the full core and single bundle computational model in Fig. 13 and Fig. 14, respectively. As noted previously, no plutonium is present at zero burnup, but rather plutonium begins to buildup in the model near the beginning of the burnup of the models.

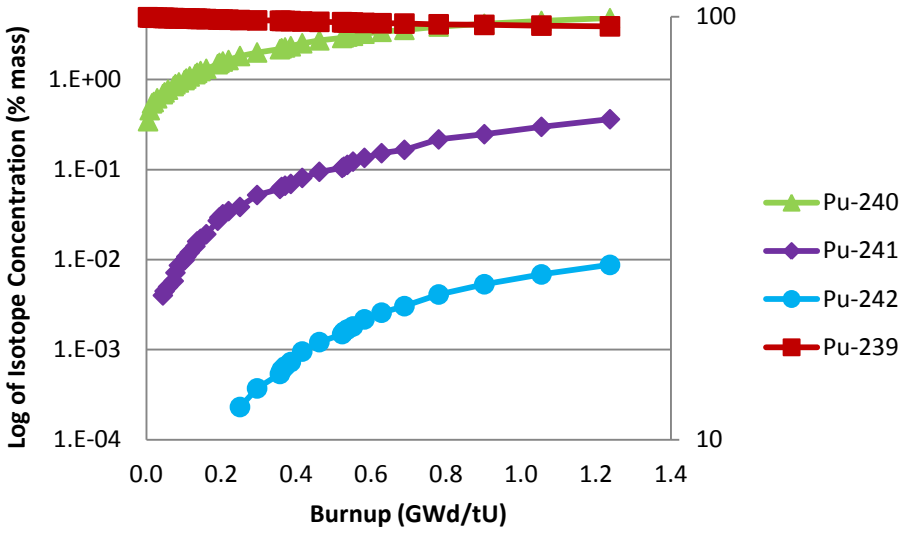


Fig. 13. The percent mass of various plutonium isotopes in the full core computational model versus burnup. Note, ^{239}Pu is represented on the alternative axis.

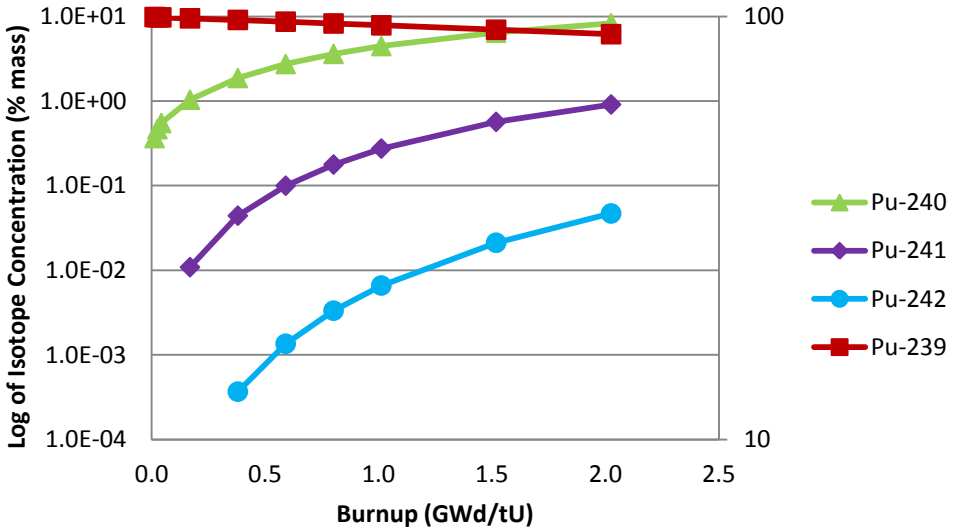


Fig. 14. The percent mass of various plutonium isotopes in the single bundle computational model versus burnup. Note, ^{239}Pu is represented on the alternative axis.

^{238}Pu was not included in the plot as it encompassed less than 0.01 % of the plutonium composition. As is can be seen in Fig. 13 and Fig. 14, the plutonium buildup trends mimic those seen at equivalent burnup levels in Fig. 1. Concentrations of ^{239}Pu are the highest throughout followed by concentrations of ^{240}Pu, ^{241}Pu, and ^{242}Pu. Also, it can be seen that ^{240}Pu begins to buildup almost immediately then slightly higher isotopes follow once enough time has elapsed to allow for the appropriate neutron captures to occur. Due to the plutonium isotope concentrations versus burnup it can be concluded that the computational model for both the full core and single bundle are simulating as expected and are therefore verified for analysis in this thesis work.

Second, the $_{137}$Cs concentration in the single bundle model was checked against the burnup level. Since ^{137}Cs is a direct fission product, it was expected that the concentration of ^{137}Cs would increase linearly with the burnup level of the fuel. The ^{137}Cs concentration versus burnup level can be seen for the single bundle computational model in Fig. 15. As it can be seen in Fig. 15, the ^{137}Cs buildup is verified for the single bundle computational model based on the R^2 being equal to 1.0, hence showing a linear trend.

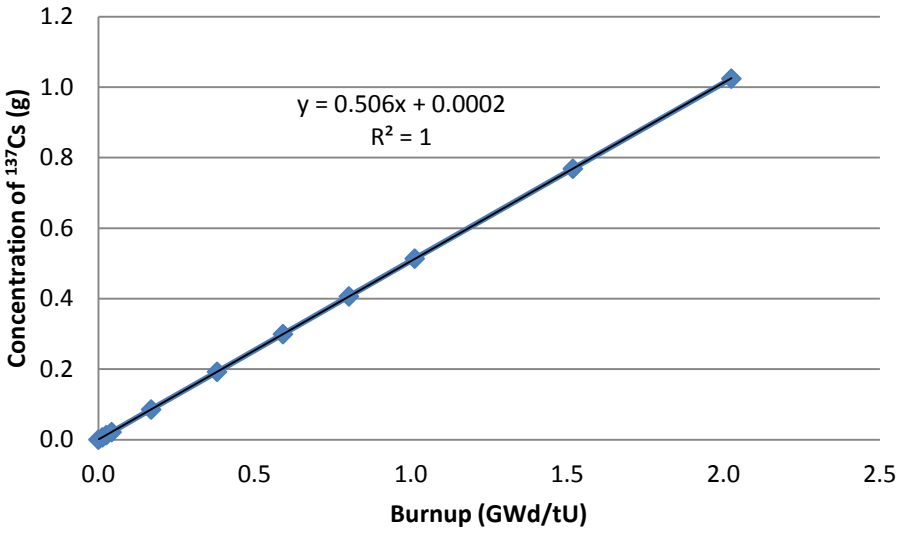


Fig. 15. ^{137}Cs concentration versus burnup in the single bundle computational model.

IV. RESULTS AND DISCUSSION

IV.A. Weapons-Grade Plutonium Production

The average burnup of used fuel discharged from an Indian 220 MWe PHWR is 6.3 GWd/tU. The plutonium produced in the used fuel is of reactor-grade with plutonium isotopes ^{239}Pu, ^{240}Pu, ^{241}Pu, ^{242}Pu in relative percentages of 68.8, 24.6, 5.3, and 1.3, respectively.[31] However, the current thesis work calls for an estimate of the isotopic concentrations in low-burnup fuel at 1 GWd/tU and 2 GWd/tU that would be obtained if the reactor is misused to produce weapons-grade plutonium instead of the reactor-grade plutonium. The plutonium isotopes production was estimated using the single PHWR 19-pin fuel bundle model with reflective boundary conditions on all sides discussed in Chapter III. Again, MCNPX 2.7 burnup/depletion code coupled with CINDER90 was used to complete the simulations, and the results obtained are shown in Table V.

TABLE V

Plutonium Produced in a Single PHWR 19-Pin Fuel Bundle

Irradiation Time (Days)	Burnup (GWd/tU)	Total mass of Pu (grams)	Plutonium Isotopic Composition (%)			
			^{239}Pu	^{240}Pu	^{241}Pu	^{242}Pu
24 (and 60 days decay)	1.012	10.23	95.98	3.78	0.23	0.01
48 (and 60 days decay)	2.025	21.96	91.54	7.58	0.83	0.04

Results from Table V show that the plutonium produced at the low-burnup level of 1 GWd/tU was of weapons-grade, and the plutonium produced at 2 GWd/tU was very close to weapons-grade. The ^{238}Pu produced was less than 0.01%. Even though only about 10 or 20 grams of plutonium was produced in a single fuel bundle, it is worth noting that a PHWR contains a total of 3600 fuel bundles in the reactor core. One Significant Quantity (SQ) of plutonium is 8 kg, and a SQ is defined as the approximate amount of nuclear material for which the possibility of manufacturing a nuclear explosive device cannot be excluded.[32] Therefore, it would require diversion of about 400 bundles to acquire 1 significant quantity of plutonium.

IV.B. Isotopic Analysis

Once the simulations were completed, an analysis of various isotopes was necessary to determine if the intrinsic physical characteristics of elemental isotopics in chemically separated weapons-grade plutonium produced from low-burnup fuel of PHWRs is differentiable from other reacto types. The results from the PHWR simulation were compared with the simulation results of a FBR, obtained through private communication, to determine the difference of the elemental isotopics between the two reactor types.[33]

IV.B.1. Isotope Selection and Detection Method

MCNPX 2.7 produced isotopic information, including concentration and activity, for a vast number of isotopes within its output. Each of these isotopes could be used for analysis and comparison to determine the intrinsic physical characteristics of elemental isotopics in chemically-separated weapons-grade plutonium produced from the low-

burnup fuel of a PHWR. Every possible isotope, along with its associated information from a single fuel bundle at a burnup of 1 GWd/tU, which could be used for the analysis of the PHWR elemental isotopics, is shown in Table VI. These same isotopes, along with their associated information, can be used for the analysis of PHWR fuel at a burnup of 2 GWd/tU.

Table VI.

Isotopic Content for One Fuel Bundle From a PHWR at 1 GWd/tU

Isotope	Zaid	Mass (gm)	Activity (Ci)	Half - Life
^{78}Se	34078	9.33E-04	0.00E+00	Stable
^{79}Se	34079	2.08E-03	2.86E-04	
^{80}Se	34080	5.92E-03	0.00E+00	Stable
^{82}Se	34082	1.55E-02	4.85E-19	Stable
^{81}Br	35081	9.58E-03	0.00E+00	Stable
^{85}Rb	37085	4.52E-02	0.00E+00	Stable
^{87}Rb	37087	1.26E-01	1.08E-08	4.75E+10
^{88}Sr	38088	1.77E-01	0.00E+00	Stable
^{90}Sr	38090	2.93E-01	4.14E+01	28.79 yr
^{89}Y	39089	1.49E-01	0.00E+00	Stable
^{91}Zr	40091	1.72E-01	0.00E+00	Stable
^{92}Zr	40092	3.19E-01	0.00E+00	Stable
^{93}Zr	40093	3.43E-01	8.62E-04	1.53E+06
^{94}Zr	40094	3.54E-01	0.00E+00	Stable
^{96}Zr	40096	3.61E-01	0.00E+00	Stable
^{95}Mo	42095	1.01E-01	0.00E+00	Stable
^{97}Mo	42097	3.44E-01	0.00E+00	Stable
^{98}Mo	42098	3.40E-01	0.00E+00	Stable

Table IV Continued

Isotope	Zaid	Mass (gm)	Activity (Ci)	Half - Life
^{100}Mo	42100	3.82E-01	0.00E+00	Stable
^{99}Tc	43099	3.59E-01	6.14E-03	2.1E5 yr
^{101}Ru	44101	3.19E-01	0.00E+00	Stable
^{102}Ru	44102	2.76E-01	0.00E+00	Stable
^{104}Ru	44104	1.45E-01	0.00E+00	Stable
^{106}Ru	44106	4.26E-02	1.41E+02	373.59 d
^{103}Rh	45103	1.52E-01	0.00E+00	Stable
^{106}Pd	46106	3.31E-02	0.00E+00	Stable
^{114}Cd	48114	2.25E-03	0.00E+00	Stable
^{116}Cd	48116	1.18E-03	0.00E+00	Stable
^{115}In	49115	9.38E-04	6.62E-15	4.41E14 yr
^{117}Sn	50117	1.08E-03	0.00E+00	Stable
^{118}Sn	50118	9.96E-04	0.00E+00	Stable
^{119}Sn	50119	1.10E-03	0.00E+00	Stable
^{120}Sn	50120	1.08E-03	0.00E+00	Stable
^{122}Sn	50122	1.36E-03	0.00E+00	Stable
^{123}Sn	50123	9.57E-05	7.87E-01	129 d
^{124}Sn	50124	2.33E-03	0.00E+00	Stable
^{126}Sn	50126	5.01E-03	1.42E-04	1E5 yr
^{121}Sb	51121	1.08E-03	0.00E+00	Stable
^{123}Sb	51123	1.30E-03	0.00E+00	Stable
^{125}Sb	51125	2.86E-03	3.00E+00	2.758 yr
^{126}Te	52126	1.80E-04	0.00E+00	Stable
^{128}Te	52128	2.83E-02	0.00E+00	Stable
^{130}Te	52130	1.45E-01	0.00E+00	Stable
^{127}I	53127	1.18E-02	0.00E+00	Stable
^{129}I	53129	4.51E-02	7.97E-06	1.57E7 yr
^{133}Cs	55133	5.29E-01	0.00E+00	Stable
^{134}Cs	55134	1.57E-03	2.03E+00	2.0648 yr
^{137}Cs	55137	5.12E-01	4.45E+01	30.07 yr

Table IV Continued

Isotope	Zaid	Mass (gm)	Activity (Ci)	Half - Life
^{138}Ba	56138	5.53E-01	0.00E+00	Stable
^{139}La	57139	5.20E-01	0.00E+00	Stable
^{140}Ce	58140	5.08E-01	0.00E+00	Stable
^{142}Ce	58142	4.85E-01	2.45E-14	5E16 yr
^{144}Ce	58144	3.90E-01	1.24E+03	284.9 d
^{141}Pr	59141	3.82E-01	0.00E+00	Stable
^{143}Nd	60143	4.72E-01	0.00E+00	Stable
^{144}Nd	60144	8.63E-02	1.03E-13	2.29E15 yr
^{145}Nd	60145	3.35E-01	1.38E-14	Stable
^{146}Nd	60146	2.64E-01	0.00E+00	Stable
^{148}Nd	60148	1.59E-01	0.00E+00	Stable
^{150}Nd	60150	6.35E-02	0.00E+00	Stable
^{147}Pm	61147	1.79E-01	1.66E+02	2.6 yr
^{150}Sm	62150	8.06E-02	0.00E+00	Stable
^{151}Sm	62151	1.58E-02	4.16E-01	90 yr
^{152}Sm	62152	5.22E-02	0.00E+00	Stable
^{154}Sm	62154	9.08E-03	0.00E+00	Stable
^{153}Eu	63153	1.81E-02	0.00E+00	Stable
^{154}Eu	63154	6.31E-04	1.71E-01	8.59 yr
^{155}Eu	63155	2.58E-03	1.27E+00	4.76 yr
^{156}Gd	64156	3.87E-03	0.00E+00	Stable
^{158}Gd	64158	1.77E-03	0.00E+00	Stable
^{234}U	92234	1.49E-04	9.27E-07	2.455E5 yr
^{235}U	92235	8.11E+01	1.75E-04	7.038E8 yr
^{236}U	92236	2.24E+00	1.45E-04	2.342E7 yr
^{238}U	92238	1.34E+04	4.50E-03	4.468E9 yr
^{237}Np	93237	3.28E-02	2.31E-05	2.144E6 yr
^{238}Pu	94238	3.58E-04	6.13E-03	87.7 yr
^{239}Pu	94239	1.16E+01	7.19E-01	2.411E4 yr
^{240}Pu	94240	4.57E-01	1.04E-01	6564 yr

Table IV Continued

Isotope	Zaid	Mass (gm)	Activity (Ci)	Half - Life
^{241}Pu	94241	2.79E-02	2.88E+00	14.35 yr
^{242}Pu	94242	6.76E-04	2.68E-06	3.733E5 yr
^{241}Am	95241	2.43E-04	8.33E-04	3.733E5 yr

It would be extremely time-consuming and impractical to analyze every isotope found in the irradiated PHWR reactor fuel. Therefore, certain characteristics were evaluated to determine which all isotopes would be analyzed to best assess the intrinsic physical characteristics of elemental isotopics in chemically-separated weapons-grade plutonium produced from the low-burnup fuel of a PHWR. These isotopes aim to provide the largest discriminator between reactor types. The selection of fission product isotopes was based on (a) the amount of isotope production, at least a few pico-grams per kg of plutonium, (b) the probability of detection [high gamma energy > 100 keV, long half-life > 100 days, high radioactivity > 1 micro-curie], and (c) reactor type dependence in isotope production. The PUREX[19] plutonium reprocessing decomtamination factor (DF) of the isotope would be ideal to use; however, specific DFs on an element basis could not be found in open literature hence a DF of 10^6 was applied for all the isotopes.

Based on these three characteristics, the suite of isotopes selected for analysis were chosen to be ^{85}Rb, ^{90}Sr, ^{125}Sb, ^{134}Cs, ^{137}Cs, ^{144}Ce, ^{147}Pm, ^{148}Nd, ^{150}Sm, ^{154}Eu, ^{239}Pu,

and ^{242}Pu. These isotopes were analyzed by their ratio to total plutonium as to investigate the intrinsic physical characteristics of elemental isotopics in chemically-separated weapons-grade plutonium produced from the low-burnup fuel of a PHWR. This ratio method of analysis was ideal for this thesis work due to the specialized interest in separated weapons-grade plutonium and not just concentrations of various fission product isotopes at the end of a specified irradiation time.

IV.B.2. PHWR Isotope Ratios

The ratio method chosen for analysis gives the estimated mass and radioactivity of a specified isotope which would be present in a 1 Kg sample of separated plutonium. As previously discussed, all isotopes were analyzed with an applied decontamination factor of 10^6. A mass and activity ratio was calculated for each isotope in the selected suite, and the results are shown in Table VII. In Table VII, the isotopes have been classified into four groups namely, Gamma, Alpha, and Mass Spectrometry based on the type of detection necessary and the speed at which results could be obtained in a laboratory setting.

TABLE VII

Selected Fission Products Concentration and Activity per Kilogram of PUREX Processed Plutonium from Low-Burnup PHWR Fuel

Candidate Isotope	Burnup 1 GWd/tU		Burnup 2 GWd/tU	
	Expected mass (g) per 1 Kg Pu with DF of 10^6	Expected activity (Ci) per 1 Kg Pu with DF of 10^6	Expected mass (g) per 1 Kg Pu with DF of 10^6	Expected activity (Ci) per 1 Kg Pu with DF of 10^6
Gamma				
^{137}Cs	4.23E-05	3.68E-03	4.46E-05	4.04E-03
^{144}Ce	3.22E-05	1.03E-01	3.33E-05	1.06E-01
^{134}Cs	1.30E-07	1.68E-04	3.92E-07	5.07E-04
^{125}Sb	2.37E-07	2.48E-04	2.92E-07	3.06E-04
^{154}Eu	5.22E-08	1.41E-05	1.26E-07	3.40E-05
Alpha				
^{239}Pu	9.60E+02	5.95E+01	9.15E+02	5.69E+01
^{242}Pu	5.60E-02	2.21E-04	4.29E-01	1.70E-03
Mass Spectrometry				
^{85}Rb	3.74E-06	Stable Isotope	3.89E-06	Stable Isotope
^{90}Sr	2.43E-05	3.43E-03	2.52E-05	3.56E-03
^{148}Nd	1.31E-05	Stable Isotope	1.46E-05	Stable Isotope
^{147}Pm	1.48E-05	1.38E-02	1.52E-05	1.41E-02
^{150}Sm	6.67E-06	Stable Isotope	8.24E-06	Stable Isotope

There are several important observations which should be noted from Table VII. First, the radioactivity concentration of ^{137}Cs and ^{144}Ce isotopes were found to be

sufficiently high in 1 Kg of plutonium, and gamma radiation spectrometric measurements can be made very quickly (prompt measurements) once such a material is interdicted. Both of these isotopes undergo beta radiation decay and the gamma energy emissions (^{137}Cs: 662 keV and ^{144}Ce: 134 keV) associated with the beta decay are high enough to be detected easily. However, due to the high plutonium signatures present in the sample, chemical separation would likely be necessary in order to measure these isotopes. These isotopes also have sufficiently long half-lives (^{137}Cs: 30.1 years and ^{144}Ce: 285 days) to be found in the interdicted sample.

Second, the radioactivity of ^{239}Pu and ^{242}Pu isotopes was found to be sufficiently high in 1 Kg of plutonium and alpha radiation spectrometric measurements could be made. However, special sample preparations are needed for performing alpha radiation spectrometry, which makes this method slower than the gamma radiation measurements of ^{137}Cs and ^{144}Ce. Both ^{239}Pu and ^{242}Pu undergo alpha radiation decay (^{239}Pu: 5156 keV and ^{242}Pu: 4901 keV) and these alpha energies are distinct enough to be separately seen in the alpha spectra. These isotopes also have very long half-lives (^{239}Pu: 24110 years and ^{242}Pu: 373300 years). These isotopes can also be measured using mass spectrometry, which is also a time consuming method compared to gamma measurements. The presence of ^{242}Pu was indicative of the reactor type, due to the neutron spectral differences between PHWR reactors and fast neutron spectrum reactors. This is because of the competition between radiative neutron capture and nuclear fission reactions in ^{241}Pu. A lower amount of ^{242}Pu, through the radiative neutron capture reaction of ^{241}Pu,

was produced in fast neutron spectrum reactor because nuclear fission is more likely than radiative neutron capture at fast neutron energies.

Third, the isotopes of ^{134}Cs, ^{125}Sb, and ^{154}Eu are again on gamma measurements. But, the radioactivity concentration found for these gamma radiation emitting isotopes was less compared to the gamma measurement isotopes, ^{137}Cs and ^{144}Ce. These isotopes undergo beta radiation decay and the gamma energy emissions (^{134}Cs: 605 keV, 796 keV; ^{125}Sb: 428 keV, 600 keV; and ^{154}Eu: 123 keV, 723 keV, 873 keV, 1004 keV, 1274 keV) associated with the beta decay are high enough to be detected easily. Again, chemical separation is likely to be necessary prior to these measurements. These isotopes also have sufficiently long half-lives (^{134}Cs: 2.062 years, ^{125}Sb: 2.767 years, and ^{154}Eu: 8.6 years) to be found in the interdicted sample.

Lastly, the isotopes of ^{85}Rb, ^{90}Sr, ^{148}Nd, ^{147}Pm, and ^{150}Sm are listed for mass spectrometry measurements for two reasons, (a) ^{85}Rb, ^{148}Nd, and ^{150}Sm do not decay hence are not amenable for radiation based measurements and (b) ^{90}Sr and ^{147}Pm are pure beta radiation emitters without any gamma energy emissions. The plot of the neutron energy dependent ^{149}Sm radiative capture reaction data[35], the reaction which is responsible for the production of ^{150}Sm, is shown in Fig. 16.

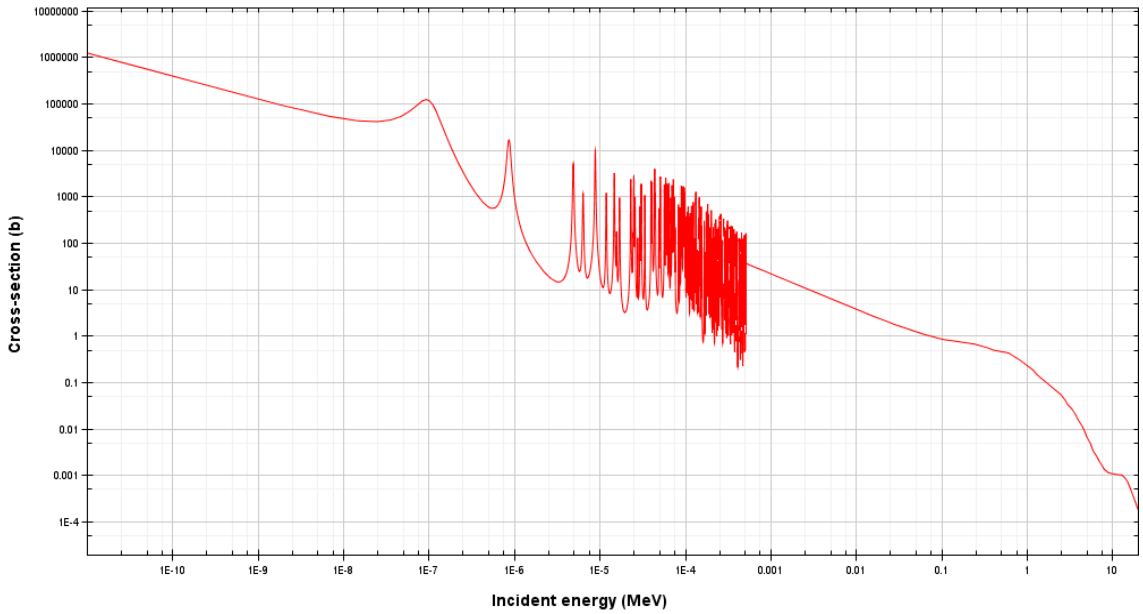


Fig. 16. The neutron radiative capture cross-section for fission product ^{149}Sm.

From Fig. 16, it can be observed that ^{150}Sm production is very sensitive to the specific reactors' neutron energy spectrum and hence is a good indicator to the differences seen in the PHWR fuel, especially when compared to a fast neutron spectrum reactor type. Between a thermal and fast neutron spectrum, ^{150}Sm production reaction neutron cross-sections differ by about 5 orders of magnitude. Therefore, it can be concluded that the probability of ^{150}Sm production from the fission product ^{149}Sm through the radiative neutron capture reaction was substantially higher in a PHWR, in which the neutron energies dominate at energies ~0.025 eV, as compared to a fast neutron spectrum reactor.

IV.B.3. PHWR to FBR Isotopic Ratios

Isotopic mass data, equivalent to the PHWR data in Table VII, was collected for FBR radial blanket fuel discharged at 1 GWd/tU through private communication.[33] The FBR isotopic mass information was compared to the PHWR isotopic mass information through another ratio. This ratio took the isotope mass per unit plutonium from the PHWR fuel and divided it by the isotope mass per unit plutonium from the FBR radial blanket fuel. A ratio was calculated for each of the selected isotopes, and the ratios comparing the two reactor types are shown in Table VIII.

TABLE VIII

Reactor Dependency of the Selected Isotope Ratios

Candidate Isotope	Ratio of expected mass PHWR/FBR
Gamma	
^{137}Cs	12.86
^{144}Ce	28.36
^{134}Cs	2.84
^{125}Sb	8.68
^{154}Eu	3.38
Alpha	
^{239}Pu	0.98
^{242}Pu	19.15

TABLEVIII Continued

Candidate Isotope	Ratio of expected mass PHWR/FBR
Mass Spectrometry	
^{85}Rb	19.98
^{90}Sr	21.69
^{148}Nd	12.56
^{147}Pm	15.44
^{150}Sm	107.01

These ratios are indicative of the differences in isotopic signatures contained in plutonium reprocessed from a used PHWR fuel bundle and FBR radial blanket fuel. Note, the large PHWR to FBR expected mass ratio of ^{150}Sm was as expected due to the difference in neutron energy spectrums, thermal versus fast, between the two reactor types, as previously discussed. These marked differences between the PHWR and the FBR isotopics observed in Table VIII show that the intrinsic physical characteristics of elemental isotopics in chemically-separated weapons-grade plutonium produced from the low-burnup fuel of a PHWR were indeed found to be differentiable from a FBR.

IV.C. Stochastic Uncertainty Estimation

The MCNPX 2.7 code used to perform the fuel burnup simulations is based on the principles of statistical stochastic procedures for solving Boltzmann radiation transport equation, as previously discussed. Because of the stochastic nature of the

solution method, the burnup simulations were repeated by altering the stochastic procedures to estimate the stochastic uncertainty (random error) associated with the predicted values of fission product and actinide isotopes concentration. Burnup simulations were repeated and the random seed number (a method used in MCNP to change the stochastic sampling procedures) was altered for each simulation. The isotope concentrations were estimated with each altered random seed number. The average mass or radioactivity concentration (μ) and one sigma standard deviation (σ) value for each isotope was calculated from the results of 9 independent simulations. The relative random error (σ/μ) thus obtained expressed in percentage for each isotope concentration is listed in Table IX. From Table IX, it can be observed that the relative random error for the isotopes was found to be very small and falls within the range of 0.00 % to 0.37%. Therefore, it can be concluded that the sampling of MCNPX 2.7 did not introduce large errors in the isotope concentration estimates. Other forms of error could be present; however, these were not characterized in this work.

TABLE IX

Stochastic Uncertainty Estimates of a Single PHWR Fuel Bundle

	Relative Random Error (%)	
Isotope	1.012 GWD/tU	2.025 GWD/tU
^{137}Cs	0.01	0.00
^{144}Ce	0.01	0.01
^{239}Pu	0.01	0.03
^{242}Pu	0.09	0.11
^{134}Cs	0.37	0.07
^{125}Sb	0.01	0.01
^{154}Eu	0.01	0.03
^{85}Rb	0.01	0.01
^{90}Sr	0.01	0.01
^{148}Nd	0.00	0.02
^{147}Pm	0.04	0.01
^{150}Sm	0.01	0.03

V. FUTURE WORK

The focus of this thesis work was (i) to computationally predict the fission product and actinide isotopic content as well as characteristics of low-burnup (1 to 2 GWd/tU) Indian 220 MWe PHWR natural uranium dioxide fuel, and (ii) to compare the predicted results with that of the low-burnup depleted uranium dioxide radial blanket fuel of a FBR. The objective was then to determine the differences in the fission products and actinide isotopic signatures in the chemically separated plutonium from low-burnup uranium fuel irradiated in these two nuclear reactor types. The objective was accomplished through PHWR modeling using the MCNPX-2.7 computer code and performing fuel burnup simulations. The computational results obtained from the PHWR fuel were presented in this thesis and were compared with that of the FBR radial blanket fuel.

Future work could be taken up by someone to validate these computational predictions by performing neutron irradiations of natural uranium dioxide fuel in a thermal neutron environment (to mimic PHWR neutron irradiation) and depleted uranium dioxide fuel in a fast neutron environment (to mimic FBR neutron irradiation). Both would be irradiated to a low-burnup of 1 to 2 GWd/tU. These neutron irradiated samples could then be chemically reprocessed to separate the plutonium from the low-burnup uranium dioxide fuel using the PUREX process (practiced in India) to determine the trace fission product and actinide isotopic content in the separated plutonium.

VI. SUMMARY AND CONCLUSIONS

This thesis work analyzed the computationally predicted intrinsic physical characteristics of the elemental isotopics found in chemically-separated weapons-grade plutonium produced from low-burnup fuel of PHWRs. These characteristics were analyzed to determine their differentiable characteristics and if nuclear forensics methods could be used to identify a source reactor type (in the event that unknown plutonium is intercepted). The determination of isotopic concentrations in weapons-grade plutonium from a PHWR was achieved through computational modeling and by performing burnup simulations. The intrinsic physical characteristics found in the separated PHWR weapons-grade plutonium were compared to that found from a FBR.

The computational modeling code MCNPX-2.7 was used to model the PHWR, based on the Indian 220 MWe PHWR. The full core of the PHWR was modeled initially. Refueling was simulated regularly to mimic the typical operation of a PHWR until the desired burnup of 1 GWd/tU was achieved. Also, a single bundle of PHWR reactor fuel with reflective boundary conditions on all sides was modeled, and a burnup simulation was completed until desired burnups of 1 GWd/tU and 2 GWd/tU were achieved. It was determined that the single bundle model was sufficient for isotopic analysis. Also, radial and axial analyses were completed, and it was determined that one radial and one axial region was sufficient for computational modeling purposes.

Once the burnup simulations were completed, the plutonium isotopics were evaluated to confirm weapons-grade plutonium was indeed produced at each of the desired burnup levels. At a burnup of 1 GWd/tU, 10.23 g of plutonium was produced in

a single bundle of fuel. At a burnup of 1 GWd/tU with a 60 day decay period, it was found that 12.09 g of plutonium was produced. The difference in pluotnium concentrations was found to be due to the decay of ^{239}Np over the 60 days. ^{239}Np has a half-life of 2.36 days which indicates all of the ^{239}Np was assumed to have decayed over the 60 days. Although the total concentration of plutonium differed after the decay period was added, the plutonium itself was weapons-grade in both cases. A similar situation was seen at a burnup of 2 GWd/tU with and without the 60 days of decay. The total amount of plutonium produced increased once the decay was added due to ^{239}Np decays, but the plutonium remained slightly below the weapons-grade classification. Therefore, it can be concluded that even after a long decay period, the plutonium isotopics will not alter in a way that changes its classification.

A suite of isotopic ratios were calculated for the PHWR at each of the desired burnup levels. These ratios at 1 GWd/tU were also compared to those calculated from the FBR to highlight the differences between the two reactor types. It was concluded from the ratio analysis that differences existed between the two reactor types, exposing the differences in the intrinsic physical characteristics found in separated weapons-grade plutonium from a PHWR and a FBR. A few isotopes whos ratios concluded large differences between the two reactor types were ^{150}Sm (100), ^{144}Ce (28), and ^{242}Pu (19). These isotopes displayed differences due to their production being dependent on fast and thermal energy. If different reactor types were selected, different isotopes would be chosen to exploite the differences between those specific reactors.

Uncertainty estimates were calculated for each of the isotopes selected for analysis. The relative random error (σ/μ) was determined in percentage for each isotope concentration. This relative random error was very small and fell within the range of 0.00 % to 0.37%. Therefore, it was concluded that the stochastic nature of MCNPX-2.7 code did not introduce large errors in the isotope concentration estimates.

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APPENDIX A

```
Indian 19-Element Bundle
c ** Cell Cards **
1   1  -10.2144   -1  59          u=1  imp:n=1  vol=78.9937  $ fuel
2   4  -1.785E-4   1 -2  59       u=1  imp:n=1   $ gap
3   2  -6.74       2 -3  59       u=1  imp:n=1   $ clad
4   1  -10.2144   -4  59          u=1  imp:n=1  vol=78.9937  $ fuel
5   4  -1.785E-4   4 -5  59       u=1  imp:n=1   $ gap
6   2  -6.74       5 -6  59       u=1  imp:n=1   $ clad
7   1  -10.2144   -7  59          u=1  imp:n=1  vol=78.9937  $ fuel
8   4  -1.785E-4   7 -8  59       u=1  imp:n=1   $ gap
9   2  -6.74       8 -9  59       u=1  imp:n=1   $ clad
10  1  -10.2144   -10   59        u=1  imp:n=1  vol=78.9937  $ fuel
11  4  -1.785E-4   10 -11  59     u=1  imp:n=1   $ gap
12  2  -6.74       11 -12  59     u=1  imp:n=1   $ clad
13  1  -10.2144   -13  59         u=1  imp:n=1  vol=78.9937  $ fuel
14  4  -1.785E-4   13 -14  59     u=1  imp:n=1   $ gap
15  2  -6.74       14 -15  59     u=1  imp:n=1   $ clad
16  1  -10.2144   -16  59         u=1  imp:n=1  vol=78.9937  $ fuel
17  4  -1.785E-4   16 -17  59     u=1  imp:n=1   $ gap
18  2  -6.74       17 -18  59     u=1  imp:n=1   $ clad
19  1  -10.2144   -19  59         u=1  imp:n=1  vol=78.9937  $ fuel
20  4  -1.785E-4   19 -20  59     u=1  imp:n=1   $ gap
21  2  -6.74       20 -21  59     u=1  imp:n=1   $ clad
22  1  -10.2144   -22  59         u=1  imp:n=1  vol=78.9937  $ fuel
23  4  -1.785E-4   22 -23  59     u=1  imp:n=1   $ gap
24  2  -6.74       23 -24  59     u=1  imp:n=1   $ clad
25  1  -10.2144   -25  59         u=1  imp:n=1  vol=78.9937  $ fuel
26  4  -1.785E-4   25 -26  59     u=1  imp:n=1   $ gap
27  2  -6.74       26 -27  59     u=1  imp:n=1   $ clad
28  1  -10.2144   -28  59         u=1  imp:n=1  vol=78.9937  $ fuel
29  4  -1.785E-4   28 -29  59     u=1  imp:n=1   $ gap
30  2  -6.74       29 -30  59     u=1  imp:n=1   $ clad
31  1  -10.2144   -31  59         u=1  imp:n=1  vol=78.9937  $ fuel
32  4  -1.785E-4   31 -32  59     u=1  imp:n=1   $ gap
33  2  -6.74       32 -33  59     u=1  imp:n=1   $ clad
34  1  -10.2144   -34  59         u=1  imp:n=1  vol=78.9937  $ fuel
35  4  -1.785E-4   34 -35  59     u=1  imp:n=1   $ gap
36  2  -6.74       35 -36  59     u=1  imp:n=1   $ clad
37  1  -10.2144   -37  59         u=1  imp:n=1  vol=78.9937  $ fuel
38  4  -1.785E-4   37 -38  59     u=1  imp:n=1   $ gap
39  2  -6.74       38 -39  59     u=1  imp:n=1   $ clad
40  1  -10.2144   -40  59         u=1  imp:n=1  vol=78.9937  $ fuel
41  4  -1.785E-4   40 -41  59     u=1  imp:n=1   $ gap
42  2  -6.74       41 -42  59     u=1  imp:n=1   $ clad
43  1  -10.2144   -43  59         u=1  imp:n=1  vol=78.9937  $ fuel
44  4  -1.785E-4   43 -44  59     u=1  imp:n=1   $ gap
45  2  -6.74       44 -45  59     u=1  imp:n=1   $ clad
46  1  -10.2144   -46  59         u=1  imp:n=1  vol=78.9937  $ fuel
47  4  -1.785E-4   46 -47  59     u=1  imp:n=1   $ gap
48  2  -6.74       47 -48  59     u=1  imp:n=1   $ clad
49  1  -10.2144   -49  59         u=1  imp:n=1  vol=78.9937  $ fuel
50  4  -1.785E-4   49 -50  59     u=1  imp:n=1   $ gap
```

```
51  2  -6.74       50 -51  59     u=1  imp:n=1   $ clad
52  1  -10.2144   -52  59         u=1  imp:n=1  vol=78.9937  $ fuel
53  4  -1.785E-4   52 -53  59     u=1  imp:n=1   $ gap
54  2  -6.74       53 -54  59     u=1  imp:n=1   $ clad
55  1  -10.2144   -55  59         u=1  imp:n=1  vol=78.9937  $ fuel
56  4  -1.785E-4   55 -56  59     u=1  imp:n=1   $ gap
57  2  -6.74       56 -57  59     u=1  imp:n=1   $ clad
58  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=1  imp:n=1    $ D2O coolant
59  3  -0.8143    -59 -60          u=1  imp:n=1    $ spacer
C     ***********************************************************************
60  7  -10.2144   -1  59          u=4  imp:n=1  vol=78.9937  $ fuel
61  4  -1.785E-4   1 -2  59       u=4  imp:n=1   $ gap
62  2  -6.74       2 -3  59       u=4  imp:n=1   $ clad
63  7  -10.2144   -4  59          u=4  imp:n=1  vol=78.9937  $ fuel
64  4  -1.785E-4   4 -5  59       u=4  imp:n=1   $ gap
65  2  -6.74       5 -6  59       u=4  imp:n=1   $ clad
66  7  -10.2144   -7  59          u=4  imp:n=1  vol=78.9937  $ fuel
67  4  -1.785E-4   7 -8  59       u=4  imp:n=1   $ gap
68  2  -6.74       8 -9  59       u=4  imp:n=1   $ clad
69  7  -10.2144   -10  59         u=4  imp:n=1  vol=78.9937  $ fuel
70  4  -1.785E-4   10 -11  59     u=4  imp:n=1   $ gap
71  2  -6.74       11 -12  59     u=4  imp:n=1   $ clad
72  7  -10.2144   -13  59         u=4  imp:n=1  vol=78.9937  $ fuel
73  4  -1.785E-4   13 -14  59     u=4  imp:n=1   $ gap
74  2  -6.74       14 -15  59     u=4  imp:n=1   $ clad
75  7  -10.2144   -16  59         u=4  imp:n=1  vol=78.9937  $ fuel
76  4  -1.785E-4   16 -17  59     u=4  imp:n=1   $ gap
77  2  -6.74       17 -18  59     u=4  imp:n=1   $ clad
78  7  -10.2144   -19  59         u=4  imp:n=1  vol=78.9937  $ fuel
79  4  -1.785E-4   19 -20  59     u=4  imp:n=1   $ gap
80  2  -6.74       20 -21  59     u=4  imp:n=1   $ clad
81  7  -10.2144   -22  59         u=4  imp:n=1  vol=78.9937  $ fuel
82  4  -1.785E-4   22 -23  59     u=4  imp:n=1   $ gap
83  2  -6.74       23 -24  59     u=4  imp:n=1   $ clad
84  7  -10.2144   -25  59         u=4  imp:n=1  vol=78.9937  $ fuel
85  4  -1.785E-4   25 -26  59     u=4  imp:n=1   $ gap
86  2  -6.74       26 -27  59     u=4  imp:n=1   $ clad
87  7  -10.2144   -28  59         u=4  imp:n=1  vol=78.9937  $ fuel
88  4  -1.785E-4   28 -29  59     u=4  imp:n=1   $ gap
89  2  -6.74       29 -30  59     u=4  imp:n=1   $ clad
90  7  -10.2144   -31  59         u=4  imp:n=1  vol=78.9937  $ fuel
91  4  -1.785E-4   31 -32  59     u=4  imp:n=1   $ gap
92  2  -6.74       32 -33  59     u=4  imp:n=1   $ clad
93  7  -10.2144   -34  59         u=4  imp:n=1  vol=78.9937  $ fuel
94  4  -1.785E-4   34 -35  59     u=4  imp:n=1   $ gap
95  2  -6.74       35 -36  59     u=4  imp:n=1   $ clad
96  7  -10.2144   -37  59         u=4  imp:n=1  vol=78.9937  $ fuel
97  4  -1.785E-4   37 -38  59     u=4  imp:n=1   $ gap
98  2  -6.74       38 -39  59     u=4  imp:n=1   $ clad
99  7  -10.2144   -40  59         u=4  imp:n=1  vol=78.9937  $ fuel
100  4  -1.785E-4   40 -41  59     u=4  imp:n=1   $ gap
101  2  -6.74       41 -42  59     u=4  imp:n=1   $ clad
102  7  -10.2144   -43  59         u=4  imp:n=1  vol=78.9937  $ fuel
103  4  -1.785E-4   43 -44  59     u=4  imp:n=1   $ gap
```

```
104  2  -6.74       44 -45  59     u=4  imp:n=1   $ clad
105  7  -10.2144   -46  59         u=4  imp:n=1  vol=78.9937  $ fuel
106  4  -1.785E-4   46 -47  59     u=4  imp:n=1   $ gap
107  2  -6.74       47 -48  59     u=4  imp:n=1   $ clad
108  7  -10.2144   -49  59         u=4  imp:n=1  vol=78.9937  $ fuel
109  4  -1.785E-4   49 -50  59     u=4  imp:n=1   $ gap
110  2  -6.74       50 -51  59     u=4  imp:n=1   $ clad
111  7  -10.2144   -52  59         u=4  imp:n=1  vol=78.9937  $ fuel
112  4  -1.785E-4   52 -53  59     u=4  imp:n=1   $ gap
113  2  -6.74       53 -54  59     u=4  imp:n=1   $ clad
114  7  -10.2144   -55  59         u=4  imp:n=1  vol=78.9937  $ fuel
115  4  -1.785E-4   55 -56  59     u=4  imp:n=1   $ gap
116  2  -6.74       56 -57  59     u=4  imp:n=1   $ clad
117  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)      u=4  imp:n=1    $ D2O coolant
118  3  -0.8143    -59 -60          u=4  imp:n=1    $ spacer
C ********************************************************************
119   21  -10.2144   -1  59          u=21  imp:n=1  vol=78.9937  $ fuel
120   4  -1.785E-4   1 -2  59       u=21  imp:n=1   $ gap
121   2  -6.74       2 -3  59       u=21  imp:n=1   $ clad
122   21  -10.2144   -4  59          u=21  imp:n=1  vol=78.9937  $ fuel
123   4  -1.785E-4   4 -5  59       u=21  imp:n=1   $ gap
124   2  -6.74       5 -6  59       u=21  imp:n=1   $ clad
125   21  -10.2144   -7  59          u=21  imp:n=1  vol=78.9937  $ fuel
126   4  -1.785E-4   7 -8  59       u=21  imp:n=1   $ gap
127   2  -6.74       8 -9  59       u=21  imp:n=1   $ clad
128  21  -10.2144   -10   59        u=21  imp:n=1  vol=78.9937  $ fuel
129  4  -1.785E-4   10 -11  59     u=21  imp:n=1   $ gap
130  2  -6.74       11 -12  59     u=21  imp:n=1   $ clad
131  21  -10.2144   -13  59         u=21  imp:n=1  vol=78.9937  $ fuel
132  4  -1.785E-4   13 -14  59     u=21  imp:n=1   $ gap
133  2  -6.74       14 -15  59     u=21  imp:n=1   $ clad
134  21  -10.2144   -16  59         u=21  imp:n=1  vol=78.9937  $ fuel
135  4  -1.785E-4   16 -17  59     u=21  imp:n=1   $ gap
136  2  -6.74       17 -18  59     u=21  imp:n=1   $ clad
137  21  -10.2144   -19  59         u=21  imp:n=1  vol=78.9937  $ fuel
138  4  -1.785E-4   19 -20  59     u=21  imp:n=1   $ gap
139  2  -6.74       20 -21  59     u=21  imp:n=1   $ clad
140  21  -10.2144   -22  59         u=21  imp:n=1  vol=78.9937  $ fuel
141  4  -1.785E-4   22 -23  59     u=21  imp:n=1   $ gap
142  2  -6.74       23 -24  59     u=21  imp:n=1   $ clad
143  21  -10.2144   -25  59         u=21  imp:n=1  vol=78.9937  $ fuel
144  4  -1.785E-4   25 -26  59     u=21  imp:n=1   $ gap
145  2  -6.74       26 -27  59     u=21  imp:n=1   $ clad
146  21  -10.2144   -28  59         u=21  imp:n=1  vol=78.9937  $ fuel
147  4  -1.785E-4   28 -29  59     u=21  imp:n=1   $ gap
148  2  -6.74       29 -30  59     u=21  imp:n=1   $ clad
149  21  -10.2144   -31  59         u=21  imp:n=1  vol=78.9937  $ fuel
150  4  -1.785E-4   31 -32  59     u=21  imp:n=1   $ gap
151  2  -6.74       32 -33  59     u=21  imp:n=1   $ clad
152  21  -10.2144   -34  59         u=21  imp:n=1  vol=78.9937  $ fuel
153  4  -1.785E-4   34 -35  59     u=21  imp:n=1   $ gap
154  2  -6.74       35 -36  59     u=21  imp:n=1   $ clad
155  21  -10.2144   -37  59         u=21  imp:n=1  vol=78.9937  $ fuel
156  4  -1.785E-4   37 -38  59     u=21  imp:n=1   $ gap
```

```
157  2  -6.74       38 -39  59     u=21  imp:n=1   $ clad
158  21  -10.2144   -40  59         u=21  imp:n=1  vol=78.9937  $ fuel
159  4  -1.785E-4   40 -41  59     u=21  imp:n=1   $ gap
160  2  -6.74       41 -42  59     u=21  imp:n=1   $ clad
161  21  -10.2144   -43  59         u=21  imp:n=1  vol=78.9937  $ fuel
162  4  -1.785E-4   43 -44  59     u=21  imp:n=1   $ gap
163  2  -6.74       44 -45  59     u=21  imp:n=1   $ clad
164  21  -10.2144   -46  59         u=21  imp:n=1  vol=78.9937  $ fuel
165  4  -1.785E-4   46 -47  59     u=21  imp:n=1   $ gap
166  2  -6.74       47 -48  59     u=21  imp:n=1   $ clad
167  21  -10.2144   -49  59         u=21  imp:n=1  vol=78.9937  $ fuel
168  4  -1.785E-4   49 -50  59     u=21  imp:n=1   $ gap
169  2  -6.74       50 -51  59     u=21  imp:n=1   $ clad
170  21  -10.2144   -52  59         u=21  imp:n=1  vol=78.9937  $ fuel
171  4  -1.785E-4   52 -53  59     u=21  imp:n=1   $ gap
172  2  -6.74       53 -54  59     u=21  imp:n=1   $ clad
173  21  -10.2144   -55  59         u=21  imp:n=1  vol=78.9937  $ fuel
174  4  -1.785E-4   55 -56  59     u=21  imp:n=1   $ gap
175  2  -6.74       56 -57  59     u=21  imp:n=1   $ clad
176  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=21  imp:n=1    $ D2O coolant
177  3  -0.8143    -59 -60          u=21  imp:n=1    $ spacer
C      ************************************************************
178   22  -10.2144   -1  59          u=22  imp:n=1  vol=78.9937  $ fuel
179   4  -1.785E-4   1 -2  59       u=22  imp:n=1   $ gap
180   2  -6.74       2 -3  59       u=22  imp:n=1   $ clad
181   22  -10.2144   -4  59          u=22  imp:n=1  vol=78.9937  $ fuel
182   4  -1.785E-4   4 -5  59       u=22  imp:n=1   $ gap
183   2  -6.74       5 -6  59       u=22  imp:n=1   $ clad
184   22  -10.2144   -7  59          u=22  imp:n=1  vol=78.9937  $ fuel
185   4  -1.785E-4   7 -8  59       u=22  imp:n=1   $ gap
186   2  -6.74       8 -9  59       u=22  imp:n=1   $ clad
187  22  -10.2144   -10   59        u=22  imp:n=1  vol=78.9937  $ fuel
188  4  -1.785E-4   10 -11  59     u=22  imp:n=1   $ gap
189  2  -6.74       11 -12  59     u=22  imp:n=1   $ clad
190  22  -10.2144   -13  59         u=22  imp:n=1  vol=78.9937  $ fuel
191  4  -1.785E-4   13 -14  59     u=22  imp:n=1   $ gap
192  2  -6.74       14 -15  59     u=22  imp:n=1   $ clad
193  22  -10.2144   -16  59         u=22  imp:n=1  vol=78.9937  $ fuel
194  4  -1.785E-4   16 -17  59     u=22  imp:n=1   $ gap
195  2  -6.74       17 -18  59     u=22  imp:n=1   $ clad
196  22  -10.2144   -19  59         u=22  imp:n=1  vol=78.9937  $ fuel
197  4  -1.785E-4   19 -20  59     u=22  imp:n=1   $ gap
198  2  -6.74       20 -21  59     u=22  imp:n=1   $ clad
199  22  -10.2144   -22  59         u=22  imp:n=1  vol=78.9937  $ fuel
200  4  -1.785E-4   22 -23  59     u=22  imp:n=1   $ gap
201  2  -6.74       23 -24  59     u=22  imp:n=1   $ clad
202  22  -10.2144   -25  59         u=22  imp:n=1  vol=78.9937  $ fuel
203  4  -1.785E-4   25 -26  59     u=22  imp:n=1   $ gap
204  2  -6.74       26 -27  59     u=22  imp:n=1   $ clad
205  22  -10.2144   -28  59         u=22  imp:n=1  vol=78.9937  $ fuel
206  4  -1.785E-4   28 -29  59     u=22  imp:n=1   $ gap
207  2  -6.74       29 -30  59     u=22  imp:n=1   $ clad
208  22  -10.2144   -31  59         u=22  imp:n=1  vol=78.9937  $ fuel
209  4  -1.785E-4   31 -32  59     u=22  imp:n=1   $ gap
```

```
210  2  -6.74       32 -33  59     u=22  imp:n=1   $ clad
211  22  -10.2144   -34  59         u=22  imp:n=1  vol=78.9937  $ fuel
212  4  -1.785E-4   34 -35  59     u=22  imp:n=1   $ gap
213  2  -6.74       35 -36  59     u=22  imp:n=1   $ clad
214  22  -10.2144   -37  59         u=22  imp:n=1  vol=78.9937  $ fuel
215  4  -1.785E-4   37 -38  59     u=22  imp:n=1   $ gap
216  2  -6.74       38 -39  59     u=22  imp:n=1   $ clad
217  22  -10.2144   -40  59         u=22  imp:n=1  vol=78.9937  $ fuel
218  4  -1.785E-4   40 -41  59     u=22  imp:n=1   $ gap
219  2  -6.74       41 -42  59     u=22  imp:n=1   $ clad
220  22  -10.2144   -43  59         u=22  imp:n=1  vol=78.9937  $ fuel
221  4  -1.785E-4   43 -44  59     u=22  imp:n=1   $ gap
222  2  -6.74       44 -45  59     u=22  imp:n=1   $ clad
223  22  -10.2144   -46  59         u=22  imp:n=1  vol=78.9937  $ fuel
224  4  -1.785E-4   46 -47  59     u=22  imp:n=1   $ gap
225  2  -6.74       47 -48  59     u=22  imp:n=1   $ clad
226  22  -10.2144   -49  59         u=22  imp:n=1  vol=78.9937  $ fuel
227  4  -1.785E-4   49 -50  59     u=22  imp:n=1   $ gap
228  2  -6.74       50 -51  59     u=22  imp:n=1   $ clad
229  22  -10.2144   -52  59         u=22  imp:n=1  vol=78.9937  $ fuel
230  4  -1.785E-4   52 -53  59     u=22  imp:n=1   $ gap
231  2  -6.74       53 -54  59     u=22  imp:n=1   $ clad
232  22  -10.2144   -55  59         u=22  imp:n=1  vol=78.9937  $ fuel
233  4  -1.785E-4   55 -56  59     u=22  imp:n=1   $ gap
234  2  -6.74       56 -57  59     u=22  imp:n=1   $ clad
235  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=22  imp:n=1    $ D2O coolant
236  3  -0.8143    -59 -60          u=22  imp:n=1    $ spacer
C      ********************************************************************
237   24  -10.2144   -1  59          u=24  imp:n=1  vol=78.9937  $ fuel
238   4  -1.785E-4   1 -2  59       u=24  imp:n=1   $ gap
239   2  -6.74       2 -3  59       u=24  imp:n=1   $ clad
240   24  -10.2144   -4  59          u=24  imp:n=1  vol=78.9937  $ fuel
241   4  -1.785E-4   4 -5  59       u=24  imp:n=1   $ gap
242   2  -6.74       5 -6  59       u=24  imp:n=1   $ clad
243   24  -10.2144   -7  59          u=24  imp:n=1  vol=78.9937  $ fuel
244   4  -1.785E-4   7 -8  59       u=24  imp:n=1   $ gap
245   2  -6.74       8 -9  59       u=24  imp:n=1   $ clad
246  24  -10.2144   -10   59        u=24  imp:n=1  vol=78.9937  $ fuel
247  4  -1.785E-4   10 -11  59     u=24  imp:n=1   $ gap
248  2  -6.74       11 -12  59     u=24  imp:n=1   $ clad
249  24  -10.2144   -13  59         u=24  imp:n=1  vol=78.9937  $ fuel
250  4  -1.785E-4   13 -14  59     u=24  imp:n=1   $ gap
251  2  -6.74       14 -15  59     u=24  imp:n=1   $ clad
252  24  -10.2144   -16  59         u=24  imp:n=1  vol=78.9937  $ fuel
253  4  -1.785E-4   16 -17  59     u=24  imp:n=1   $ gap
254  2  -6.74       17 -18  59     u=24  imp:n=1   $ clad
255  24  -10.2144   -19  59         u=24  imp:n=1  vol=78.9937  $ fuel
256  4  -1.785E-4   19 -20  59     u=24  imp:n=1   $ gap
257  2  -6.74       20 -21  59     u=24  imp:n=1   $ clad
258  24  -10.2144   -22  59         u=24  imp:n=1  vol=78.9937  $ fuel
259  4  -1.785E-4   22 -23  59     u=24  imp:n=1   $ gap
260  2  -6.74       23 -24  59     u=24  imp:n=1   $ clad
261  24  -10.2144   -25  59         u=24  imp:n=1  vol=78.9937  $ fuel
262  4  -1.785E-4   25 -26  59     u=24  imp:n=1   $ gap
```

```
263  2  -6.74       26 -27  59     u=24  imp:n=1   $ clad
264  24  -10.2144   -28  59         u=24  imp:n=1  vol=78.9937  $ fuel
265  4  -1.785E-4   28 -29  59     u=24  imp:n=1   $ gap
266  2  -6.74       29 -30  59     u=24  imp:n=1   $ clad
267  24  -10.2144   -31  59         u=24  imp:n=1  vol=78.9937  $ fuel
268  4  -1.785E-4   31 -32  59     u=24  imp:n=1   $ gap
269  2  -6.74       32 -33  59     u=24  imp:n=1   $ clad
270  24  -10.2144   -34  59         u=24  imp:n=1  vol=78.9937  $ fuel
271  4  -1.785E-4   34 -35  59     u=24  imp:n=1   $ gap
272  2  -6.74       35 -36  59     u=24  imp:n=1   $ clad
273  24  -10.2144   -37  59         u=24  imp:n=1  vol=78.9937  $ fuel
274  4  -1.785E-4   37 -38  59     u=24  imp:n=1   $ gap
275  2  -6.74       38 -39  59     u=24  imp:n=1   $ clad
276  24  -10.2144   -40  59         u=24  imp:n=1  vol=78.9937  $ fuel
277  4  -1.785E-4   40 -41  59     u=24  imp:n=1   $ gap
278  2  -6.74       41 -42  59     u=24  imp:n=1   $ clad
279  24  -10.2144   -43  59         u=24  imp:n=1  vol=78.9937  $ fuel
280  4  -1.785E-4   43 -44  59     u=24  imp:n=1   $ gap
281  2  -6.74       44 -45  59     u=24  imp:n=1   $ clad
282  24  -10.2144   -46  59         u=24  imp:n=1  vol=78.9937  $ fuel
283  4  -1.785E-4   46 -47  59     u=24  imp:n=1   $ gap
284  2  -6.74       47 -48  59     u=24  imp:n=1   $ clad
285  24  -10.2144   -49  59         u=24  imp:n=1  vol=78.9937  $ fuel
286  4  -1.785E-4   49 -50  59     u=24  imp:n=1   $ gap
287  2  -6.74       50 -51  59     u=24  imp:n=1   $ clad
288  24  -10.2144   -52  59         u=24  imp:n=1  vol=78.9937  $ fuel
289  4  -1.785E-4   52 -53  59     u=24  imp:n=1   $ gap
290  2  -6.74       53 -54  59     u=24  imp:n=1   $ clad
291  24  -10.2144   -55  59         u=24  imp:n=1  vol=78.9937  $ fuel
292  4  -1.785E-4   55 -56  59     u=24  imp:n=1   $ gap
293  2  -6.74       56 -57  59     u=24  imp:n=1   $ clad
294  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=24  imp:n=1    $ D2O coolant
295  3  -0.8143    -59 -60          u=24  imp:n=1    $ spacer
C      ************************************************************
296   31  -10.2144   -1  59          u=31  imp:n=1  vol=78.9937  $ fuel
297   4  -1.785E-4   1 -2  59       u=31  imp:n=1   $ gap
298   2  -6.74       2 -3  59       u=31  imp:n=1   $ clad
299   31  -10.2144   -4  59         u=31  imp:n=1  vol=78.9937  $ fuel
300   4  -1.785E-4   4 -5  59       u=31  imp:n=1   $ gap
301   2  -6.74       5 -6  59       u=31  imp:n=1   $ clad
302   31  -10.2144   -7  59         u=31  imp:n=1  vol=78.9937  $ fuel
303   4  -1.785E-4   7 -8  59       u=31  imp:n=1   $ gap
304   2  -6.74       8 -9  59       u=31  imp:n=1   $ clad
305  31  -10.2144   -10   59        u=31  imp:n=1  vol=78.9937  $ fuel
306  4  -1.785E-4   10 -11  59     u=31  imp:n=1   $ gap
307  2  -6.74       11 -12  59     u=31  imp:n=1   $ clad
308  31  -10.2144   -13  59         u=31  imp:n=1  vol=78.9937  $ fuel
309  4  -1.785E-4   13 -14  59     u=31  imp:n=1   $ gap
310  2  -6.74       14 -15  59     u=31  imp:n=1   $ clad
311  31  -10.2144   -16  59         u=31  imp:n=1  vol=78.9937  $ fuel
312  4  -1.785E-4   16 -17  59     u=31  imp:n=1   $ gap
313  2  -6.74       17 -18  59     u=31  imp:n=1   $ clad
314  31  -10.2144   -19  59         u=31  imp:n=1  vol=78.9937  $ fuel
315  4  -1.785E-4   19 -20  59     u=31  imp:n=1   $ gap
```

```
316  2  -6.74       20 -21  59     u=31  imp:n=1   $ clad
317  31  -10.2144   -22  59         u=31  imp:n=1  vol=78.9937  $ fuel
318  4  -1.785E-4   22 -23  59     u=31  imp:n=1   $ gap
319  2  -6.74       23 -24  59     u=31  imp:n=1   $ clad
320  31  -10.2144   -25  59         u=31  imp:n=1  vol=78.9937  $ fuel
321  4  -1.785E-4   25 -26  59     u=31  imp:n=1   $ gap
322  2  -6.74       26 -27  59     u=31  imp:n=1   $ clad
323  31  -10.2144   -28  59         u=31  imp:n=1  vol=78.9937  $ fuel
324  4  -1.785E-4   28 -29  59     u=31  imp:n=1   $ gap
325  2  -6.74       29 -30  59     u=31  imp:n=1   $ clad
326  31  -10.2144   -31  59         u=31  imp:n=1  vol=78.9937  $ fuel
327  4  -1.785E-4   31 -32  59     u=31  imp:n=1   $ gap
328  2  -6.74       32 -33  59     u=31  imp:n=1   $ clad
329  31  -10.2144   -34  59         u=31  imp:n=1  vol=78.9937  $ fuel
330  4  -1.785E-4   34 -35  59     u=31  imp:n=1   $ gap
331  2  -6.74       35 -36  59     u=31  imp:n=1   $ clad
332  31  -10.2144   -37  59         u=31  imp:n=1  vol=78.9937  $ fuel
333  4  -1.785E-4   37 -38  59     u=31  imp:n=1   $ gap
334  2  -6.74       38 -39  59     u=31  imp:n=1   $ clad
335  31  -10.2144   -40  59         u=31  imp:n=1  vol=78.9937  $ fuel
336  4  -1.785E-4   40 -41  59     u=31  imp:n=1   $ gap
337  2  -6.74       41 -42  59     u=31  imp:n=1   $ clad
338  31  -10.2144   -43  59         u=31  imp:n=1  vol=78.9937  $ fuel
339  4  -1.785E-4   43 -44  59     u=31  imp:n=1   $ gap
340  2  -6.74       44 -45  59     u=31  imp:n=1   $ clad
341  31  -10.2144   -46  59         u=31  imp:n=1  vol=78.9937  $ fuel
342  4  -1.785E-4   46 -47  59     u=31  imp:n=1   $ gap
343  2  -6.74       47 -48  59     u=31  imp:n=1   $ clad
344  31  -10.2144   -49  59         u=31  imp:n=1  vol=78.9937  $ fuel
345  4  -1.785E-4   49 -50  59     u=31  imp:n=1   $ gap
346  2  -6.74       50 -51  59     u=31  imp:n=1   $ clad
347  31  -10.2144   -52  59         u=31  imp:n=1  vol=78.9937  $ fuel
348  4  -1.785E-4   52 -53  59     u=31  imp:n=1   $ gap
349  2  -6.74       53 -54  59     u=31  imp:n=1   $ clad
350  31  -10.2144   -55  59         u=31  imp:n=1  vol=78.9937  $ fuel
351  4  -1.785E-4   55 -56  59     u=31  imp:n=1   $ gap
352  2  -6.74       56 -57  59     u=31  imp:n=1   $ clad
353  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=31  imp:n=1    $ D2O coolant
354  3  -0.8143    -59 -60          u=31  imp:n=1    $ spacer
C      ************************************************************
355   32  -10.2144   -1  59         u=32  imp:n=1  vol=78.9937  $ fuel
356   4  -1.785E-4   1 -2  59       u=32  imp:n=1   $ gap
357   2  -6.74       2 -3  59       u=32  imp:n=1   $ clad
358   32  -10.2144   -4  59         u=32  imp:n=1  vol=78.9937  $ fuel
359   4  -1.785E-4   4 -5  59       u=32  imp:n=1   $ gap
360   2  -6.74       5 -6  59       u=32  imp:n=1   $ clad
361   32  -10.2144   -7  59         u=32  imp:n=1  vol=78.9937  $ fuel
362   4  -1.785E-4   7 -8  59       u=32  imp:n=1   $ gap
363   2  -6.74       8 -9  59       u=32  imp:n=1   $ clad
364  32  -10.2144   -10   59       u=32  imp:n=1  vol=78.9937  $ fuel
365  4  -1.785E-4   10 -11  59     u=32  imp:n=1   $ gap
366  2  -6.74       11 -12  59     u=32  imp:n=1   $ clad
367  32  -10.2144   -13  59        u=32  imp:n=1  vol=78.9937  $ fuel
368  4  -1.785E-4   13 -14  59     u=32  imp:n=1   $ gap
```

```
369  2  -6.74       14 -15  59     u=32  imp:n=1   $ clad
370  32  -10.2144   -16  59        u=32  imp:n=1  vol=78.9937  $ fuel
371  4  -1.785E-4   16 -17  59     u=32  imp:n=1   $ gap
372  2  -6.74       17 -18  59     u=32  imp:n=1   $ clad
373  32  -10.2144   -19  59        u=32  imp:n=1  vol=78.9937  $ fuel
374  4  -1.785E-4   19 -20  59     u=32  imp:n=1   $ gap
375  2  -6.74       20 -21  59     u=32  imp:n=1   $ clad
376  32  -10.2144   -22  59        u=32  imp:n=1  vol=78.9937  $ fuel
377  4  -1.785E-4   22 -23  59     u=32  imp:n=1   $ gap
378  2  -6.74       23 -24  59     u=32  imp:n=1   $ clad
379  32  -10.2144   -25  59        u=32  imp:n=1  vol=78.9937  $ fuel
380  4  -1.785E-4   25 -26  59     u=32  imp:n=1   $ gap
381  2  -6.74       26 -27  59     u=32  imp:n=1   $ clad
382  32  -10.2144   -28  59        u=32  imp:n=1  vol=78.9937  $ fuel
383  4  -1.785E-4   28 -29  59     u=32  imp:n=1   $ gap
384  2  -6.74       29 -30  59     u=32  imp:n=1   $ clad
385  32  -10.2144   -31  59        u=32  imp:n=1  vol=78.9937  $ fuel
386  4  -1.785E-4   31 -32  59     u=32  imp:n=1   $ gap
387  2  -6.74       32 -33  59     u=32  imp:n=1   $ clad
388  32  -10.2144   -34  59        u=32  imp:n=1  vol=78.9937  $ fuel
389  4  -1.785E-4   34 -35  59     u=32  imp:n=1   $ gap
390  2  -6.74       35 -36  59     u=32  imp:n=1   $ clad
391  32  -10.2144   -37  59        u=32  imp:n=1  vol=78.9937  $ fuel
392  4  -1.785E-4   37 -38  59     u=32  imp:n=1   $ gap
393  2  -6.74       38 -39  59     u=32  imp:n=1   $ clad
394  32  -10.2144   -40  59        u=32  imp:n=1  vol=78.9937  $ fuel
395  4  -1.785E-4   40 -41  59     u=32  imp:n=1   $ gap
396  2  -6.74       41 -42  59     u=32  imp:n=1   $ clad
397  32  -10.2144   -43  59        u=32  imp:n=1  vol=78.9937  $ fuel
398  4  -1.785E-4   43 -44  59     u=32  imp:n=1   $ gap
399  2  -6.74       44 -45  59     u=32  imp:n=1   $ clad
400  32  -10.2144   -46  59        u=32  imp:n=1  vol=78.9937  $ fuel
401  4  -1.785E-4   46 -47  59     u=32  imp:n=1   $ gap
402  2  -6.74       47 -48  59     u=32  imp:n=1   $ clad
403  32  -10.2144   -49  59        u=32  imp:n=1  vol=78.9937  $ fuel
404  4  -1.785E-4   49 -50  59     u=32  imp:n=1   $ gap
405  2  -6.74       50 -51  59     u=32  imp:n=1   $ clad
406  32  -10.2144   -52  59        u=32  imp:n=1  vol=78.9937  $ fuel
407  4  -1.785E-4   52 -53  59     u=32  imp:n=1   $ gap
408  2  -6.74       53 -54  59     u=32  imp:n=1   $ clad
409  32  -10.2144   -55  59        u=32  imp:n=1  vol=78.9937  $ fuel
410  4  -1.785E-4   55 -56  59     u=32  imp:n=1   $ gap
411  2  -6.74       56 -57  59     u=32  imp:n=1   $ clad
412  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=32  imp:n=1    $ D2O coolant
413  3  -0.8143    -59 -60          u=32  imp:n=1    $ spacer
C      ************************************************************
414   34  -10.2144   -1  59         u=34  imp:n=1  vol=78.9937  $ fuel
415   4  -1.785E-4   1 -2  59       u=34  imp:n=1   $ gap
416   2  -6.74       2 -3  59       u=34  imp:n=1   $ clad
417   34  -10.2144   -4  59         u=34  imp:n=1  vol=78.9937  $ fuel
418   4  -1.785E-4   4 -5  59       u=34  imp:n=1   $ gap
419   2  -6.74       5 -6  59       u=34  imp:n=1   $ clad
420   34  -10.2144   -7  59         u=34  imp:n=1  vol=78.9937  $ fuel
421   4  -1.785E-4   7 -8  59       u=34  imp:n=1   $ gap
```

```
422   2  -6.74       8 -9  59       u=34  imp:n=1   $ clad
423  34  -10.2144   -10   59        u=34  imp:n=1  vol=78.9937  $ fuel
424  4  -1.785E-4   10 -11  59     u=34  imp:n=1   $ gap
425  2  -6.74       11 -12  59     u=34  imp:n=1   $ clad
426  34  -10.2144   -13  59         u=34  imp:n=1  vol=78.9937  $ fuel
427  4  -1.785E-4   13 -14  59     u=34  imp:n=1   $ gap
428  2  -6.74       14 -15  59     u=34  imp:n=1   $ clad
429  34  -10.2144   -16  59         u=34  imp:n=1  vol=78.9937  $ fuel
430  4  -1.785E-4   16 -17  59     u=34  imp:n=1   $ gap
431  2  -6.74       17 -18  59     u=34  imp:n=1   $ clad
432  34  -10.2144   -19  59         u=34  imp:n=1  vol=78.9937  $ fuel
433  4  -1.785E-4   19 -20  59     u=34  imp:n=1   $ gap
434  2  -6.74       20 -21  59     u=34  imp:n=1   $ clad
435  34  -10.2144   -22  59         u=34  imp:n=1  vol=78.9937  $ fuel
436  4  -1.785E-4   22 -23  59     u=34  imp:n=1   $ gap
437  2  -6.74       23 -24  59     u=34  imp:n=1   $ clad
438  34  -10.2144   -25  59         u=34  imp:n=1  vol=78.9937  $ fuel
439  4  -1.785E-4   25 -26  59     u=34  imp:n=1   $ gap
440  2  -6.74       26 -27  59     u=34  imp:n=1   $ clad
441  34  -10.2144   -28  59         u=34  imp:n=1  vol=78.9937  $ fuel
442  4  -1.785E-4   28 -29  59     u=34  imp:n=1   $ gap
443  2  -6.74       29 -30  59     u=34  imp:n=1   $ clad
444  34  -10.2144   -31  59         u=34  imp:n=1  vol=78.9937  $ fuel
445  4  -1.785E-4   31 -32  59     u=34  imp:n=1   $ gap
446  2  -6.74       32 -33  59     u=34  imp:n=1   $ clad
447  34  -10.2144   -34  59         u=34  imp:n=1  vol=78.9937  $ fuel
448  4  -1.785E-4   34 -35  59     u=34  imp:n=1   $ gap
449  2  -6.74       35 -36  59     u=34  imp:n=1   $ clad
450  34  -10.2144   -37  59         u=34  imp:n=1  vol=78.9937  $ fuel
451  4  -1.785E-4   37 -38  59     u=34  imp:n=1   $ gap
452  2  -6.74       38 -39  59     u=34  imp:n=1   $ clad
453  34  -10.2144   -40  59         u=34  imp:n=1  vol=78.9937  $ fuel
454  4  -1.785E-4   40 -41  59     u=34  imp:n=1   $ gap
455  2  -6.74       41 -42  59     u=34  imp:n=1   $ clad
456  34  -10.2144   -43  59         u=34  imp:n=1  vol=78.9937  $ fuel
457  4  -1.785E-4   43 -44  59     u=34  imp:n=1   $ gap
458  2  -6.74       44 -45  59     u=34  imp:n=1   $ clad
459  34  -10.2144   -46  59         u=34  imp:n=1  vol=78.9937  $ fuel
460  4  -1.785E-4   46 -47  59     u=34  imp:n=1   $ gap
461  2  -6.74       47 -48  59     u=34  imp:n=1   $ clad
462  34  -10.2144   -49  59         u=34  imp:n=1  vol=78.9937  $ fuel
463  4  -1.785E-4   49 -50  59     u=34  imp:n=1   $ gap
464  2  -6.74       50 -51  59     u=34  imp:n=1   $ clad
465  34  -10.2144   -52  59         u=34  imp:n=1  vol=78.9937  $ fuel
466  4  -1.785E-4   52 -53  59     u=34  imp:n=1   $ gap
467  2  -6.74       53 -54  59     u=34  imp:n=1   $ clad
468  34  -10.2144   -55  59         u=34  imp:n=1  vol=78.9937  $ fuel
469  4  -1.785E-4   55 -56  59     u=34  imp:n=1   $ gap
470  2  -6.74       56 -57  59     u=34  imp:n=1   $ clad
471  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=34  imp:n=1    $ D2O coolant
472  3  -0.8143    -59 -60          u=34  imp:n=1    $ spacer
C      ********************************************************************
473   41  -10.2144   -1  59          u=41  imp:n=1  vol=78.9937  $ fuel
474   4  -1.785E-4   1 -2  59       u=41  imp:n=1   $ gap
```

```
475   2  -6.74       2 -3  59       u=41  imp:n=1   $ clad
476   41  -10.2144   -4  59         u=41  imp:n=1  vol=78.9937  $ fuel
477   4  -1.785E-4   4 -5  59       u=41  imp:n=1   $ gap
478   2  -6.74       5 -6  59       u=41  imp:n=1   $ clad
479   41  -10.2144   -7  59         u=41  imp:n=1  vol=78.9937  $ fuel
480   4  -1.785E-4   7 -8  59       u=41  imp:n=1   $ gap
481   2  -6.74       8 -9  59       u=41  imp:n=1   $ clad
482  41  -10.2144   -10   59       u=41  imp:n=1  vol=78.9937  $ fuel
483  4  -1.785E-4   10 -11  59     u=41  imp:n=1   $ gap
484  2  -6.74       11 -12  59     u=41  imp:n=1   $ clad
485  41  -10.2144   -13  59        u=41  imp:n=1  vol=78.9937  $ fuel
486  4  -1.785E-4   13 -14  59     u=41  imp:n=1   $ gap
487  2  -6.74       14 -15  59     u=41  imp:n=1   $ clad
488  41  -10.2144   -16  59        u=41  imp:n=1  vol=78.9937  $ fuel
489  4  -1.785E-4   16 -17  59     u=41  imp:n=1   $ gap
490  2  -6.74       17 -18  59     u=41  imp:n=1   $ clad
491  41  -10.2144   -19  59        u=41  imp:n=1  vol=78.9937  $ fuel
492  4  -1.785E-4   19 -20  59     u=41  imp:n=1   $ gap
493  2  -6.74       20 -21  59     u=41  imp:n=1   $ clad
494  41  -10.2144   -22  59        u=41  imp:n=1  vol=78.9937  $ fuel
495  4  -1.785E-4   22 -23  59     u=41  imp:n=1   $ gap
496  2  -6.74       23 -24  59     u=41  imp:n=1   $ clad
497  41  -10.2144   -25  59        u=41  imp:n=1  vol=78.9937  $ fuel
498  4  -1.785E-4   25 -26  59     u=41  imp:n=1   $ gap
499  2  -6.74       26 -27  59     u=41  imp:n=1   $ clad
500  41  -10.2144   -28  59        u=41  imp:n=1  vol=78.9937  $ fuel
501  4  -1.785E-4   28 -29  59     u=41  imp:n=1   $ gap
502  2  -6.74       29 -30  59     u=41  imp:n=1   $ clad
503  41  -10.2144   -31  59         u=41  imp:n=1  vol=78.9937  $ fuel
504  4  -1.785E-4   31 -32  59     u=41  imp:n=1   $ gap
505 2  -6.74       32 -33  59     u=41  imp:n=1   $ clad
506  41  -10.2144   -34  59        u=41  imp:n=1  vol=78.9937  $ fuel
507  4  -1.785E-4   34 -35  59     u=41  imp:n=1   $ gap
508  2  -6.74       35 -36  59     u=41  imp:n=1   $ clad
509  41  -10.2144   -37  59        u=41  imp:n=1  vol=78.9937  $ fuel
510  4  -1.785E-4   37 -38  59     u=41  imp:n=1   $ gap
511  2  -6.74       38 -39  59     u=41  imp:n=1   $ clad
512  41  -10.2144   -40  59        u=41  imp:n=1  vol=78.9937  $ fuel
513  4  -1.785E-4   40 -41  59     u=41  imp:n=1   $ gap
514  2  -6.74       41 -42  59     u=41  imp:n=1   $ clad
515  41  -10.2144   -43  59        u=41  imp:n=1  vol=78.9937  $ fuel
516  4  -1.785E-4   43 -44  59     u=41  imp:n=1   $ gap
517  2  -6.74       44 -45  59     u=41  imp:n=1   $ clad
518  41  -10.2144   -46  59        u=41  imp:n=1  vol=78.9937  $ fuel
519  4  -1.785E-4   46 -47  59     u=41  imp:n=1   $ gap
520  2  -6.74       47 -48  59     u=41  imp:n=1   $ clad
521  41  -10.2144   -49  59        u=41  imp:n=1  vol=78.9937  $ fuel
522  4  -1.785E-4   49 -50  59     u=41  imp:n=1   $ gap
523  2  -6.74       50 -51  59     u=41  imp:n=1   $ clad
524  41  -10.2144   -52  59        u=41  imp:n=1  vol=78.9937  $ fuel
525  4  -1.785E-4   52 -53  59     u=41  imp:n=1   $ gap
526  2  -6.74       53 -54  59     u=41  imp:n=1   $ clad
527  41  -10.2144   -55  59        u=41  imp:n=1  vol=78.9937  $ fuel
528  4  -1.785E-4   55 -56  59     u=41  imp:n=1   $ gap
529  2  -6.74       56 -57  59     u=41  imp:n=1   $ clad
```

```
530  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=41  imp:n=1    $ D2O coolant
531  3  -0.8143    -59 -60          u=41  imp:n=1    $ spacer
C      ************************************************************
532   42  -10.2144   -1  59          u=42  imp:n=1  vol=78.9937  $ fuel
533   4  -1.785E-4   1 -2  59       u=42  imp:n=1   $ gap
534   2  -6.74       2 -3  59       u=42  imp:n=1   $ clad
535   42  -10.2144   -4  59         u=42  imp:n=1  vol=78.9937  $ fuel
536   4  -1.785E-4   4 -5  59       u=42  imp:n=1   $ gap
537   2  -6.74       5 -6  59       u=42  imp:n=1   $ clad
538   42  -10.2144   -7  59         u=42  imp:n=1  vol=78.9937  $ fuel
539   4  -1.785E-4   7 -8  59       u=42  imp:n=1   $ gap
540   2  -6.74       8 -9  59       u=42  imp:n=1   $ clad
541  42  -10.2144   -10   59       u=42  imp:n=1  vol=78.9937  $ fuel
542  4  -1.785E-4   10 -11  59     u=42  imp:n=1   $ gap
543  2  -6.74       11 -12  59     u=42  imp:n=1   $ clad
544  42  -10.2144   -13  59        u=42  imp:n=1  vol=78.9937  $ fuel
545  4  -1.785E-4   13 -14  59     u=42  imp:n=1   $ gap
546  2  -6.74       14 -15  59     u=42  imp:n=1   $ clad
547  42  -10.2144   -16  59        u=42  imp:n=1  vol=78.9937  $ fuel
548  4  -1.785E-4   16 -17  59     u=42  imp:n=1   $ gap
549  2  -6.74       17 -18  59     u=42  imp:n=1   $ clad
550  42  -10.2144   -19  59        u=42  imp:n=1  vol=78.9937  $ fuel
551  4  -1.785E-4   19 -20  59     u=42  imp:n=1   $ gap
552  2  -6.74       20 -21  59     u=42  imp:n=1   $ clad
553  42  -10.2144   -22  59        u=42  imp:n=1  vol=78.9937  $ fuel
554  4  -1.785E-4   22 -23  59     u=42  imp:n=1   $ gap
555  2  -6.74       23 -24  59     u=42  imp:n=1   $ clad
556  42  -10.2144   -25  59        u=42  imp:n=1  vol=78.9937  $ fuel
557  4  -1.785E-4   25 -26  59     u=42  imp:n=1   $ gap
558  2  -6.74       26 -27  59     u=42  imp:n=1   $ clad
559  42  -10.2144   -28  59        u=42  imp:n=1  vol=78.9937  $ fuel
560  4  -1.785E-4   28 -29  59     u=42  imp:n=1   $ gap
561  2  -6.74       29 -30  59     u=42  imp:n=1   $ clad
562  42  -10.2144   -31  59         u=42  imp:n=1  vol=78.9937  $ fuel
563  4  -1.785E-4   31 -32  59     u=42  imp:n=1   $ gap
564  2  -6.74       32 -33  59     u=42  imp:n=1   $ clad
565  42  -10.2144   -34  59        u=42  imp:n=1  vol=78.9937  $ fuel
566  4  -1.785E-4   34 -35  59     u=42  imp:n=1   $ gap
567  2  -6.74       35 -36  59     u=42  imp:n=1   $ clad
568  42  -10.2144   -37  59        u=42  imp:n=1  vol=78.9937  $ fuel
569  4  -1.785E-4   37 -38  59     u=42  imp:n=1   $ gap
570  2  -6.74       38 -39  59     u=42  imp:n=1   $ clad
571  42  -10.2144   -40  59        u=42  imp:n=1  vol=78.9937  $ fuel
572  4  -1.785E-4   40 -41  59     u=42  imp:n=1   $ gap
573  2  -6.74       41 -42  59     u=42  imp:n=1   $ clad
574  42  -10.2144   -43  59        u=42  imp:n=1  vol=78.9937  $ fuel
575  4  -1.785E-4   43 -44  59     u=42  imp:n=1   $ gap
576  2  -6.74       44 -45  59     u=42  imp:n=1   $ clad
577  42  -10.2144   -46  59        u=42  imp:n=1  vol=78.9937  $ fuel
578  4  -1.785E-4   46 -47  59     u=42 imp:n=1   $ gap
579  2  -6.74       47 -48  59     u=42  imp:n=1   $ clad
580  42  -10.2144   -49  59        u=42  imp:n=1  vol=78.9937  $ fuel
581  4  -1.785E-4   49 -50  59     u=42  imp:n=1   $ gap
582  2  -6.74       50 -51  59     u=42  imp:n=1   $ clad
```

```
583  42  -10.2144   -52  59        u=42  imp:n=1  vol=78.9937  $ fuel
584  4  -1.785E-4   52 -53  59     u=42  imp:n=1   $ gap
585  2  -6.74       53 -54  59     u=42  imp:n=1   $ clad
586  42  -10.2144   -55  59        u=42  imp:n=1  vol=78.9937  $ fuel
587  4  -1.785E-4   55 -56  59     u=42  imp:n=1   $ gap
588  2  -6.74       56 -57  59     u=42  imp:n=1   $ clad
589  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=42  imp:n=1    $ D2O coolant
590  3  -0.8143    -59 -60          u=42  imp:n=1    $ spacer
C      ***************************************************************
591   44  -10.2144   -1  59         u=44  imp:n=1  vol=78.9937  $ fuel
592   4  -1.785E-4   1 -2  59       u=44  imp:n=1   $ gap
593   2  -6.74       2 -3  59       u=44  imp:n=1   $ clad
594   44  -10.2144   -4  59        u=44  imp:n=1  vol=78.9937  $ fuel
595   4  -1.785E-4   4 -5  59       u=44  imp:n=1   $ gap
596   2  -6.74       5 -6  59       u=44  imp:n=1   $ clad
597   44  -10.2144   -7  59        u=44  imp:n=1  vol=78.9937  $ fuel
598   4  -1.785E-4   7 -8  59       u=44  imp:n=1   $ gap
599   2  -6.74       8 -9  59       u=44  imp:n=1   $ clad
600  44  -10.2144   -10   59       u=44  imp:n=1  vol=78.9937  $ fuel
601  4  -1.785E-4   10 -11  59     u=44  imp:n=1   $ gap
602  2  -6.74       11 -12  59     u=44  imp:n=1   $ clad
603  44  -10.2144   -13  59        u=44  imp:n=1  vol=78.9937  $ fuel
604  4  -1.785E-4   13 -14  59     u=44  imp:n=1   $ gap
605  2  -6.74       14 -15  59     u=44  imp:n=1   $ clad
606  44  -10.2144   -16  59        u=44  imp:n=1  vol=78.9937  $ fuel
607  4  -1.785E-4   16 -17  59     u=44  imp:n=1   $ gap
608  2  -6.74       17 -18  59     u=44  imp:n=1   $ clad
609  44  -10.2144   -19  59        u=44  imp:n=1  vol=78.9937  $ fuel
610  4  -1.785E-4   19 -20  59     u=44  imp:n=1   $ gap
611  2  -6.74       20 -21  59     u=44  imp:n=1   $ clad
612  44  -10.2144   -22  59        u=44  imp:n=1  vol=78.9937  $ fuel
613  4  -1.785E-4   22 -23  59     u=44  imp:n=1   $ gap
614  2  -6.74       23 -24  59     u=44  imp:n=1   $ clad
615  44  -10.2144   -25  59        u=44  imp:n=1  vol=78.9937  $ fuel
616  4  -1.785E-4   25 -26  59     u=44  imp:n=1   $ gap
617  2  -6.74       26 -27  59     u=44  imp:n=1   $ clad
618  44  -10.2144   -28  59        u=44  imp:n=1  vol=78.9937  $ fuel
619  4  -1.785E-4   28 -29  59     u=44  imp:n=1   $ gap
620  2  -6.74       29 -30  59     u=44  imp:n=1   $ clad
621  44  -10.2144   -31  59         u=44  imp:n=1  vol=78.9937  $ fuel
622  4  -1.785E-4   31 -32  59     u=44  imp:n=1   $ gap
623 2  -6.74       32 -33  59     u=44  imp:n=1   $ clad
624  44  -10.2144   -34  59        u=44  imp:n=1  vol=78.9937  $ fuel
625  4  -1.785E-4   34 -35  59     u=44  imp:n=1   $ gap
626  2  -6.74       35 -36  59     u=44  imp:n=1   $ clad
627  44  -10.2144   -37  59        u=44  imp:n=1  vol=78.9937  $ fuel
628  4  -1.785E-4   37 -38  59     u=44  imp:n=1   $ gap
629  2  -6.74       38 -39  59     u=44  imp:n=1   $ clad
630  44  -10.2144   -40  59        u=44  imp:n=1  vol=78.9937  $ fuel
631  4  -1.785E-4   40 -41  59     u=44  imp:n=1   $ gap
632  2  -6.74       41 -42  59     u=44  imp:n=1   $ clad
633  44  -10.2144   -43  59        u=44  imp:n=1  vol=78.9937  $ fuel
634  4  -1.785E-4   43 -44  59     u=44  imp:n=1   $ gap
635  2  -6.74       44 -45  59     u=44  imp:n=1   $ clad
```

```
636  44  -10.2144   -46  59        u=44  imp:n=1  vol=78.9937  $ fuel
637  4  -1.785E-4   46 -47  59     u=44  imp:n=1   $ gap
638  2  -6.74       47 -48  59     u=44  imp:n=1   $ clad
639  44  -10.2144   -49  59        u=44  imp:n=1  vol=78.9937  $ fuel
640  4  -1.785E-4   49 -50  59     u=44  imp:n=1   $ gap
641  2  -6.74       50 -51  59     u=44  imp:n=1   $ clad
642  44  -10.2144   -52  59        u=44  imp:n=1  vol=78.9937  $ fuel
643  4  -1.785E-4   52 -53  59     u=44  imp:n=1   $ gap
644  2  -6.74       53 -54  59     u=44  imp:n=1   $ clad
645  44  -10.2144   -55  59        u=44  imp:n=1  vol=78.9937  $ fuel
646  4  -1.785E-4   55 -56  59     u=44  imp:n=1   $ gap
647  2  -6.74       56 -57  59     u=44  imp:n=1   $ clad
648  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=44  imp:n=1    $ D2O coolant
649  3  -0.8143    -59 -60          u=44  imp:n=1    $ spacer
C      ************************************************************
650   51  -10.2144   -1  59         u=51  imp:n=1  vol=78.9937  $ fuel
651   4  -1.785E-4   1 -2  59       u=51  imp:n=1   $ gap
652   2  -6.74       2 -3  59       u=51  imp:n=1   $ clad
653   51  -10.2144   -4  59        u=51  imp:n=1  vol=78.9937  $ fuel
654   4  -1.785E-4   4 -5  59       u=51  imp:n=1   $ gap
655   2  -6.74       5 -6  59       u=51  imp:n=1   $ clad
656   51  -10.2144   -7  59        u=51  imp:n=1  vol=78.9937  $ fuel
657   4  -1.785E-4   7 -8  59       u=51  imp:n=1   $ gap
658   2  -6.74       8 -9  59       u=51  imp:n=1   $ clad
659  51  -10.2144   -10   59       u=51  imp:n=1  vol=78.9937  $ fuel
660  4  -1.785E-4   10 -11  59     u=51  imp:n=1   $ gap
661  2  -6.74       11 -12  59     u=51  imp:n=1   $ clad
662  51  -10.2144   -13  59        u=51  imp:n=1  vol=78.9937  $ fuel
663  4  -1.785E-4   13 -14  59     u=51  imp:n=1   $ gap
664  2  -6.74       14 -15  59     u=51  imp:n=1   $ clad
665  51  -10.2144   -16  59        u=51  imp:n=1  vol=78.9937  $ fuel
666  4  -1.785E-4   16 -17  59     u=51  imp:n=1   $ gap
667  2  -6.74       17 -18  59     u=51  imp:n=1   $ clad
668  51  -10.2144   -19  59        u=51  imp:n=1  vol=78.9937  $ fuel
669  4  -1.785E-4   19 -20  59     u=51  imp:n=1   $ gap
670  2  -6.74       20 -21  59     u=51  imp:n=1   $ clad
671  51  -10.2144   -22  59        u=51  imp:n=1  vol=78.9937  $ fuel
672  4  -1.785E-4   22 -23  59     u=51  imp:n=1   $ gap
673  2  -6.74       23 -24  59     u=51  imp:n=1   $ clad
674  51  -10.2144   -25  59        u=51  imp:n=1  vol=78.9937  $ fuel
675  4  -1.785E-4   25 -26  59     u=51  imp:n=1   $ gap
676  2  -6.74       26 -27  59     u=51  imp:n=1   $ clad
677  51  -10.2144   -28  59        u=51  imp:n=1  vol=78.9937  $ fuel
678  4  -1.785E-4   28 -29  59     u=51  imp:n=1   $ gap
679  2  -6.74       29 -30  59     u=51  imp:n=1   $ clad
680  51  -10.2144   -31  59        u=51  imp:n=1  vol=78.9937  $ fuel
681  4  -1.785E-4   31 -32  59     u=51  imp:n=1   $ gap
682  2  -6.74       32 -33  59     u=51  imp:n=1   $ clad
683  51  -10.2144   -34  59        u=51  imp:n=1  vol=78.9937  $ fuel
684  4  -1.785E-4   34 -35  59     u=51  imp:n=1   $ gap
685  2  -6.74       35 -36  59     u=51  imp:n=1   $ clad
686  51  -10.2144   -37  59        u=51  imp:n=1  vol=78.9937  $ fuel
687  4  -1.785E-4   37 -38  59     u=51  imp:n=1   $ gap
688  2  -6.74       38 -39  59     u=51  imp:n=1   $ clad
```

```
689  51  -10.2144   -40  59        u=51  imp:n=1  vol=78.9937  $ fuel
690  4  -1.785E-4   40 -41  59     u=51  imp:n=1   $ gap
691  2  -6.74       41 -42  59     u=51  imp:n=1   $ clad
692  51  -10.2144   -43  59        u=51  imp:n=1  vol=78.9937  $ fuel
693  4  -1.785E-4   43 -44  59     u=51  imp:n=1   $ gap
694  2  -6.74       44 -45  59     u=51  imp:n=1   $ clad
695  51  -10.2144   -46  59        u=51  imp:n=1  vol=78.9937  $ fuel
696  4  -1.785E-4   46 -47  59     u=51  imp:n=1   $ gap
697  2  -6.74       47 -48  59     u=51  imp:n=1   $ clad
698  51  -10.2144   -49  59        u=51  imp:n=1  vol=78.9937  $ fuel
699  4  -1.785E-4   49 -50  59     u=51  imp:n=1   $ gap
700  2  -6.74       50 -51  59     u=51  imp:n=1   $ clad
701  51  -10.2144   -52  59        u=51  imp:n=1  vol=78.9937  $ fuel
702  4  -1.785E-4   52 -53  59     u=51  imp:n=1   $ gap
703  2  -6.74       53 -54  59     u=51  imp:n=1   $ clad
704  51  -10.2144   -55  59        u=51  imp:n=1  vol=78.9937  $ fuel
705  4  -1.785E-4   55 -56  59     u=51  imp:n=1   $ gap
706  2  -6.74       56 -57  59     u=51  imp:n=1   $ clad
707  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=51  imp:n=1    $ D2O coolant
708  3  -0.8143    -59 -60          u=51  imp:n=1    $ spacer
C      ************************************************************
709   52  -10.2144   -1  59         u=52  imp:n=1  vol=78.9937  $ fuel
710   4  -1.785E-4   1 -2  59       u=52  imp:n=1   $ gap
711   2  -6.74       2 -3  59       u=52  imp:n=1   $ clad
712   52  -10.2144   -4  59        u=52  imp:n=1  vol=78.9937  $ fuel
713   4  -1.785E-4   4 -5  59       u=52  imp:n=1   $ gap
714   2  -6.74       5 -6  59       u=52  imp:n=1   $ clad
715   52  -10.2144   -7  59        u=52  imp:n=1  vol=78.9937  $ fuel
716   4  -1.785E-4   7 -8  59       u=52  imp:n=1   $ gap
717   2  -6.74       8 -9  59       u=52  imp:n=1   $ clad
718  52  -10.2144   -10   59       u=52  imp:n=1  vol=78.9937  $ fuel
719  4  -1.785E-4   10 -11  59     u=52  imp:n=1   $ gap
720  2  -6.74       11 -12  59     u=52  imp:n=1   $ clad
721  52  -10.2144   -13  59        u=52  imp:n=1  vol=78.9937  $ fuel
722  4  -1.785E-4   13 -14  59     u=52  imp:n=1   $ gap
723  2  -6.74       14 -15  59     u=52  imp:n=1   $ clad
724  52  -10.2144   -16  59        u=52  imp:n=1  vol=78.9937  $ fuel
725  4  -1.785E-4   16 -17  59     u=52  imp:n=1   $ gap
726  2  -6.74       17 -18  59     u=52  imp:n=1   $ clad
727  52  -10.2144   -19  59        u=52  imp:n=1  vol=78.9937  $ fuel
728  4  -1.785E-4   19 -20  59     u=52  imp:n=1   $ gap
729  2  -6.74       20 -21  59     u=52  imp:n=1   $ clad
730  52  -10.2144   -22  59        u=52  imp:n=1  vol=78.9937  $ fuel
731  4  -1.785E-4   22 -23  59     u=52  imp:n=1   $ gap
732  2  -6.74       23 -24  59     u=52  imp:n=1   $ clad
733  52  -10.2144   -25  59        u=52  imp:n=1  vol=78.9937  $ fuel
734  4  -1.785E-4   25 -26  59     u=52  imp:n=1   $ gap
735  2  -6.74       26 -27  59     u=52  imp:n=1   $ clad
736  52  -10.2144   -28  59        u=52  imp:n=1  vol=78.9937  $ fuel
737  4  -1.785E-4   28 -29  59     u=52  imp:n=1   $ gap
738  2  -6.74       29 -30  59     u=52  imp:n=1   $ clad
739  52  -10.2144   -31  59        u=52  imp:n=1  vol=78.9937  $ fuel
740  4  -1.785E-4   31 -32  59     u=52  imp:n=1   $ gap
741  2  -6.74       32 -33  59     u=52  imp:n=1   $ clad
```

```
742  52  -10.2144   -34  59        u=52  imp:n=1  vol=78.9937  $ fuel
743  4  -1.785E-4   34 -35  59     u=52  imp:n=1   $ gap
744  2  -6.74       35 -36  59     u=52  imp:n=1   $ clad
745  52  -10.2144   -37  59        u=52  imp:n=1  vol=78.9937  $ fuel
746  4  -1.785E-4   37 -38  59     u=52  imp:n=1   $ gap
747  2  -6.74       38 -39  59     u=52  imp:n=1   $ clad
748  52  -10.2144   -40  59        u=52  imp:n=1  vol=78.9937  $ fuel
749  4  -1.785E-4   40 -41  59     u=52  imp:n=1   $ gap
750  2  -6.74       41 -42  59     u=52  imp:n=1   $ clad
751  52  -10.2144   -43  59        u=52  imp:n=1  vol=78.9937  $ fuel
752  4  -1.785E-4   43 -44  59     u=52  imp:n=1   $ gap
753  2  -6.74       44 -45  59     u=52  imp:n=1   $ clad
754  52  -10.2144   -46  59        u=52  imp:n=1  vol=78.9937  $ fuel
755  4  -1.785E-4   46 -47  59     u=52  imp:n=1   $ gap
756  2  -6.74       47 -48  59     u=52  imp:n=1   $ clad
757  52  -10.2144   -49  59        u=52  imp:n=1  vol=78.9937  $ fuel
758  4  -1.785E-4   49 -50  59     u=52  imp:n=1   $ gap
759  2  -6.74       50 -51  59     u=52  imp:n=1   $ clad
760  52  -10.2144   -52  59        u=52  imp:n=1  vol=78.9937  $ fuel
761  4  -1.785E-4   52 -53  59     u=52  imp:n=1   $ gap
762  2  -6.74       53 -54  59     u=52  imp:n=1   $ clad
763  52  -10.2144   -55  59        u=52  imp:n=1  vol=78.9937  $ fuel
764  4  -1.785E-4   55 -56  59     u=52  imp:n=1   $ gap
765  2  -6.74       56 -57  59     u=52  imp:n=1   $ clad
766  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=52  imp:n=1    $ D2O coolant
767  3  -0.8143    -59 -60          u=52  imp:n=1    $ spacer
C      ********************************************************************
768   54  -10.2144   -1  59         u=54  imp:n=1  vol=78.9937  $ fuel
769   4  -1.785E-4   1 -2  59       u=54  imp:n=1   $ gap
770   2  -6.74       2 -3  59       u=54  imp:n=1   $ clad
771   54  -10.2144   -4  59        u=54  imp:n=1  vol=78.9937  $ fuel
772   4  -1.785E-4   4 -5  59       u=54  imp:n=1   $ gap
773   2  -6.74       5 -6  59       u=54  imp:n=1   $ clad
774   54  -10.2144   -7  59        u=54  imp:n=1  vol=78.9937  $ fuel
775   4  -1.785E-4   7 -8  59       u=54  imp:n=1   $ gap
776   2  -6.74       8 -9  59       u=54  imp:n=1   $ clad
777  54  -10.2144   -10   59       u=54  imp:n=1  vol=78.9937  $ fuel
778  4  -1.785E-4   10 -11  59     u=54  imp:n=1   $ gap
779  2  -6.74       11 -12  59     u=54  imp:n=1   $ clad
780  54  -10.2144   -13  59        u=54  imp:n=1  vol=78.9937  $ fuel
781  4  -1.785E-4   13 -14  59     u=54  imp:n=1   $ gap
782  2  -6.74       14 -15  59     u=54  imp:n=1   $ clad
783  54  -10.2144   -16  59        u=54  imp:n=1  vol=78.9937  $ fuel
784  4  -1.785E-4   16 -17  59     u=54  imp:n=1   $ gap
785  2  -6.74       17 -18  59     u=54  imp:n=1   $ clad
786  54  -10.2144   -19  59        u=54  imp:n=1  vol=78.9937  $ fuel
787  4  -1.785E-4   19 -20  59     u=54  imp:n=1   $ gap
788  2  -6.74       20 -21  59     u=54  imp:n=1   $ clad
789  54  -10.2144   -22  59        u=54  imp:n=1  vol=78.9937  $ fuel
790  4  -1.785E-4   22 -23  59     u=54  imp:n=1   $ gap
791  2  -6.74       23 -24  59     u=54  imp:n=1   $ clad
792  54  -10.2144   -25  59        u=54  imp:n=1  vol=78.9937  $ fuel
793  4  -1.785E-4   25 -26  59     u=54  imp:n=1   $ gap
794  2  -6.74       26 -27  59     u=54  imp:n=1   $ clad
```

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795  54  -10.2144   -28  59        u=54  imp:n=1  vol=78.9937  $ fuel
796  4  -1.785E-4   28 -29  59     u=54  imp:n=1   $ gap
797  2  -6.74       29 -30  59     u=54  imp:n=1   $ clad
798  54  -10.2144   -31  59        u=54  imp:n=1  vol=78.9937  $ fuel
799  4  -1.785E-4   31 -32  59     u=54  imp:n=1   $ gap
800  2  -6.74       32 -33  59     u=54  imp:n=1   $ clad
801  54  -10.2144   -34  59        u=54  imp:n=1  vol=78.9937  $ fuel
802  4  -1.785E-4   34 -35  59     u=54  imp:n=1   $ gap
803  2  -6.74       35 -36  59     u=54  imp:n=1   $ clad
804  54  -10.2144   -37  59        u=54  imp:n=1  vol=78.9937  $ fuel
805  4  -1.785E-4   37 -38  59     u=54  imp:n=1   $ gap
806  2  -6.74       38 -39  59     u=54  imp:n=1   $ clad
807  54  -10.2144   -40  59        u=54  imp:n=1  vol=78.9937  $ fuel
808  4  -1.785E-4   40 -41  59     u=54  imp:n=1   $ gap
809  2  -6.74       41 -42  59     u=54  imp:n=1   $ clad
810  54  -10.2144   -43  59        u=54  imp:n=1  vol=78.9937  $ fuel
811  4  -1.785E-4   43 -44  59     u=54  imp:n=1   $ gap
812  2  -6.74       44 -45  59     u=54  imp:n=1   $ clad
813  54  -10.2144   -46  59        u=54  imp:n=1  vol=78.9937  $ fuel
814  4  -1.785E-4   46 -47  59     u=54  imp:n=1   $ gap
815  2  -6.74       47 -48  59     u=54  imp:n=1   $ clad
816  54  -10.2144   -49  59        u=54  imp:n=1  vol=78.9937  $ fuel
817  4  -1.785E-4   49 -50  59     u=54  imp:n=1   $ gap
818  2  -6.74       50 -51  59     u=54  imp:n=1   $ clad
819  54  -10.2144   -52  59        u=54  imp:n=1  vol=78.9937  $ fuel
820  4  -1.785E-4   52 -53  59     u=54  imp:n=1   $ gap
821  2  -6.74       53 -54  59     u=54  imp:n=1   $ clad
822  54  -10.2144   -55  59        u=54  imp:n=1  vol=78.9937  $ fuel
823  4  -1.785E-4   55 -56  59     u=54  imp:n=1   $ gap
824  2  -6.74       56 -57  59     u=54  imp:n=1   $ clad
825  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=54  imp:n=1    $ D2O coolant
826  3  -0.8143    -59 -60          u=54  imp:n=1    $ spacer
C      ************************************************************
827   61  -10.2144   -1  59         u=61  imp:n=1  vol=78.9937  $ fuel
828   4  -1.785E-4   1 -2  59       u=61  imp:n=1   $ gap
829   2  -6.74       2 -3  59       u=61  imp:n=1   $ clad
830   61  -10.2144   -4  59        u=61  imp:n=1  vol=78.9937  $ fuel
831   4  -1.785E-4   4 -5  59       u=61  imp:n=1   $ gap
832   2  -6.74       5 -6  59       u=61  imp:n=1   $ clad
833   61  -10.2144   -7  59        u=61  imp:n=1  vol=78.9937  $ fuel
834   4  -1.785E-4   7 -8  59       u=61  imp:n=1   $ gap
835   2  -6.74       8 -9  59       u=61  imp:n=1   $ clad
836  61  -10.2144   -10   59       u=61  imp:n=1  vol=78.9937  $ fuel
837  4  -1.785E-4   10 -11  59     u=61  imp:n=1   $ gap
838  2  -6.74       11 -12  59     u=61  imp:n=1   $ clad
839  61  -10.2144   -13  59        u=61  imp:n=1  vol=78.9937  $ fuel
840  4  -1.785E-4   13 -14  59     u=61  imp:n=1   $ gap
841  2  -6.74       14 -15  59     u=61  imp:n=1   $ clad
842  61  -10.2144   -16  59        u=61  imp:n=1  vol=78.9937  $ fuel
843  4  -1.785E-4   16 -17  59     u=61  imp:n=1   $ gap
844  2  -6.74       17 -18  59     u=61  imp:n=1   $ clad
845  61  -10.2144   -19  59        u=61  imp:n=1  vol=78.9937  $ fuel
846  4  -1.785E-4   19 -20  59     u=61  imp:n=1   $ gap
847  2  -6.74       20 -21  59     u=61  imp:n=1   $ clad
```

```
848  61  -10.2144   -22  59        u=61  imp:n=1  vol=78.9937  $ fuel
849  4  -1.785E-4   22 -23  59     u=61  imp:n=1   $ gap
850  2  -6.74       23 -24  59     u=61  imp:n=1   $ clad
851  61  -10.2144   -25  59        u=61  imp:n=1  vol=78.9937  $ fuel
852  4  -1.785E-4   25 -26  59     u=61  imp:n=1   $ gap
853  2  -6.74       26 -27  59     u=61  imp:n=1   $ clad
854  61  -10.2144   -28  59        u=61  imp:n=1  vol=78.9937  $ fuel
855  4  -1.785E-4   28 -29  59     u=61  imp:n=1   $ gap
856  2  -6.74       29 -30  59     u=61  imp:n=1   $ clad
857  61  -10.2144   -31  59        u=61  imp:n=1  vol=78.9937  $ fuel
858  4  -1.785E-4   31 -32  59     u=61  imp:n=1   $ gap
859  2  -6.74       32 -33  59     u=61  imp:n=1   $ clad
860  61  -10.2144   -34  59        u=61  imp:n=1  vol=78.9937  $ fuel
861  4  -1.785E-4   34 -35  59     u=61  imp:n=1   $ gap
862  2  -6.74       35 -36  59     u=61  imp:n=1   $ clad
863  61  -10.2144   -37  59        u=61  imp:n=1  vol=78.9937  $ fuel
864  4  -1.785E-4   37 -38  59     u=61  imp:n=1   $ gap
865  2  -6.74       38 -39  59     u=61  imp:n=1   $ clad
866  61  -10.2144   -40  59        u=61  imp:n=1  vol=78.9937  $ fuel
867  4  -1.785E-4   40 -41  59     u=61  imp:n=1   $ gap
868  2  -6.74       41 -42  59     u=61  imp:n=1   $ clad
869  61  -10.2144   -43  59        u=61  imp:n=1  vol=78.9937  $ fuel
870  4  -1.785E-4   43 -44  59     u=61  imp:n=1   $ gap
871  2  -6.74       44 -45  59     u=61  imp:n=1   $ clad
872  61  -10.2144   -46  59        u=61  imp:n=1  vol=78.9937  $ fuel
873  4  -1.785E-4   46 -47  59     u=61  imp:n=1   $ gap
874  2  -6.74       47 -48  59     u=61  imp:n=1   $ clad
875  61  -10.2144   -49  59        u=61  imp:n=1  vol=78.9937  $ fuel
876  4  -1.785E-4   49 -50  59     u=61  imp:n=1   $ gap
877  2  -6.74       50 -51  59     u=61  imp:n=1   $ clad
878  61  -10.2144   -52  59        u=61  imp:n=1  vol=78.9937  $ fuel
879  4  -1.785E-4   52 -53  59     u=61  imp:n=1   $ gap
880  2  -6.74       53 -54  59     u=61  imp:n=1   $ clad
881  61  -10.2144   -55  59        u=61  imp:n=1  vol=78.9937  $ fuel
882  4  -1.785E-4   55 -56  59     u=61  imp:n=1   $ gap
883  2  -6.74       56 -57  59     u=61  imp:n=1   $ clad
884  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=61  imp:n=1    $ D2O coolant
885  3  -0.8143    -59 -60          u=61  imp:n=1    $ spacer
C      ************************************************************
886   62  -10.2144   -1  59         u=62  imp:n=1  vol=78.9937  $ fuel
887   4  -1.785E-4   1 -2  59       u=62  imp:n=1   $ gap
888   2  -6.74       2 -3  59       u=62  imp:n=1   $ clad
889   62  -10.2144   -4  59        u=62  imp:n=1  vol=78.9937  $ fuel
890   4  -1.785E-4   4 -5  59       u=62  imp:n=1   $ gap
891   2  -6.74       5 -6  59       u=62  imp:n=1   $ clad
892   62  -10.2144   -7  59        u=62  imp:n=1  vol=78.9937  $ fuel
893   4  -1.785E-4   7 -8  59       u=62  imp:n=1   $ gap
894   2  -6.74       8 -9  59       u=62  imp:n=1   $ clad
895  62  -10.2144   -10   59       u=62  imp:n=1  vol=78.9937  $ fuel
896  4  -1.785E-4   10 -11  59     u=62  imp:n=1   $ gap
897  2  -6.74       11 -12  59     u=62  imp:n=1   $ clad
898  62  -10.2144   -13  59        u=62  imp:n=1  vol=78.9937  $ fuel
899  4  -1.785E-4   13 -14  59     u=62  imp:n=1   $ gap
900  2  -6.74       14 -15  59     u=62  imp:n=1   $ clad
```

```
901  62  -10.2144   -16  59        u=62  imp:n=1  vol=78.9937  $ fuel
902  4  -1.785E-4   16 -17  59     u=62  imp:n=1   $ gap
903  2  -6.74       17 -18  59     u=62  imp:n=1   $ clad
904  62  -10.2144   -19  59        u=62  imp:n=1  vol=78.9937  $ fuel
905  4  -1.785E-4   19 -20  59     u=62  imp:n=1   $ gap
906  2  -6.74       20 -21  59     u=62  imp:n=1   $ clad
907  62  -10.2144   -22  59        u=62  imp:n=1  vol=78.9937  $ fuel
908  4  -1.785E-4   22 -23  59     u=62  imp:n=1   $ gap
909  2  -6.74       23 -24  59     u=62  imp:n=1   $ clad
910  62  -10.2144   -25  59        u=62  imp:n=1  vol=78.9937  $ fuel
911  4  -1.785E-4   25 -26  59     u=62  imp:n=1   $ gap
912  2  -6.74       26 -27  59     u=62  imp:n=1   $ clad
913  62  -10.2144   -28  59        u=62  imp:n=1  vol=78.9937  $ fuel
914  4  -1.785E-4   28 -29  59     u=62  imp:n=1   $ gap
915  2  -6.74       29 -30  59     u=62  imp:n=1   $ clad
916  62  -10.2144   -31  59        u=62  imp:n=1  vol=78.9937  $ fuel
917  4  -1.785E-4   31 -32  59     u=62  imp:n=1   $ gap
918  2  -6.74       32 -33  59     u=62  imp:n=1   $ clad
919  62  -10.2144   -34  59        u=62  imp:n=1  vol=78.9937  $ fuel
920  4  -1.785E-4   34 -35  59     u=62  imp:n=1   $ gap
921  2  -6.74       35 -36  59     u=62  imp:n=1   $ clad
922  62  -10.2144   -37  59        u=62  imp:n=1  vol=78.9937  $ fuel
923  4  -1.785E-4   37 -38  59     u=62  imp:n=1   $ gap
924  2  -6.74       38 -39  59     u=62  imp:n=1   $ clad
925  62  -10.2144   -40  59        u=62  imp:n=1  vol=78.9937  $ fuel
926  4  -1.785E-4   40 -41  59     u=62  imp:n=1   $ gap
927  2  -6.74       41 -42  59     u=62  imp:n=1   $ clad
928  62  -10.2144   -43  59        u=62  imp:n=1  vol=78.9937  $ fuel
929  4  -1.785E-4   43 -44  59     u=62  imp:n=1   $ gap
930  2  -6.74       44 -45  59     u=62  imp:n=1   $ clad
931  62  -10.2144   -46  59        u=62  imp:n=1  vol=78.9937  $ fuel
932  4  -1.785E-4   46 -47  59     u=62  imp:n=1   $ gap
933  2  -6.74       47 -48  59     u=62  imp:n=1   $ clad
934  62  -10.2144   -49  59        u=62  imp:n=1  vol=78.9937  $ fuel
935  4  -1.785E-4   49 -50  59     u=62  imp:n=1   $ gap
936  2  -6.74       50 -51  59     u=62  imp:n=1   $ clad
937  62  -10.2144   -52  59        u=62  imp:n=1  vol=78.9937  $ fuel
938  4  -1.785E-4   52 -53  59     u=62  imp:n=1   $ gap
939  2  -6.74       53 -54  59     u=62  imp:n=1   $ clad
940  62  -10.2144   -55  59        u=62  imp:n=1  vol=78.9937  $ fuel
941  4  -1.785E-4   55 -56  59     u=62  imp:n=1   $ gap
942  2  -6.74       56 -57  59     u=62  imp:n=1   $ clad
943  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=62  imp:n=1    $ D2O coolant
944  3  -0.8143    -59 -60          u=62  imp:n=1    $ spacer
C      ************************************************************
945   64  -10.2144   -1  59         u=64  imp:n=1  vol=78.9937  $ fuel
946   4  -1.785E-4   1 -2  59       u=64  imp:n=1   $ gap
947   2  -6.74       2 -3  59       u=64  imp:n=1   $ clad
948   64  -10.2144   -4  59        u=64  imp:n=1  vol=78.9937  $ fuel
949   4  -1.785E-4   4 -5  59       u=64  imp:n=1   $ gap
950   2  -6.74       5 -6  59       u=64  imp:n=1   $ clad
951   64  -10.2144   -7  59        u=64  imp:n=1  vol=78.9937  $ fuel
952   4  -1.785E-4   7 -8  59       u=64  imp:n=1   $ gap
953   2  -6.74       8 -9  59       u=64  imp:n=1   $ clad
```

```
954  64  -10.2144   -10   59       u=64  imp:n=1  vol=78.9937  $ fuel
955  4  -1.785E-4   10 -11  59     u=64  imp:n=1   $ gap
956  2  -6.74       11 -12  59     u=64  imp:n=1   $ clad
957  64  -10.2144   -13  59        u=64  imp:n=1  vol=78.9937  $ fuel
958  4  -1.785E-4   13 -14  59     u=64  imp:n=1   $ gap
959  2  -6.74       14 -15  59     u=64  imp:n=1   $ clad
960  64  -10.2144   -16  59        u=64  imp:n=1  vol=78.9937  $ fuel
961  4  -1.785E-4   16 -17  59     u=64  imp:n=1   $ gap
962  2  -6.74       17 -18  59     u=64  imp:n=1   $ clad
963  64  -10.2144   -19  59        u=64  imp:n=1  vol=78.9937  $ fuel
964  4  -1.785E-4   19 -20  59     u=64  imp:n=1   $ gap
965  2  -6.74       20 -21  59     u=64  imp:n=1   $ clad
966  64  -10.2144   -22  59        u=64  imp:n=1  vol=78.9937  $ fuel
967  4  -1.785E-4   22 -23  59     u=64  imp:n=1   $ gap
968  2  -6.74       23 -24  59     u=64  imp:n=1   $ clad
969  64  -10.2144   -25  59        u=64  imp:n=1  vol=78.9937  $ fuel
970  4  -1.785E-4   25 -26  59     u=64  imp:n=1   $ gap
971  2  -6.74       26 -27  59     u=64  imp:n=1   $ clad
972  64  -10.2144   -28  59        u=64  imp:n=1  vol=78.9937  $ fuel
973  4  -1.785E-4   28 -29  59     u=64  imp:n=1   $ gap
974  2  -6.74       29 -30  59     u=64  imp:n=1   $ clad
975  64  -10.2144   -31  59        u=64  imp:n=1  vol=78.9937  $ fuel
976  4  -1.785E-4   31 -32  59     u=64  imp:n=1   $ gap
977  2  -6.74       32 -33  59     u=64  imp:n=1   $ clad
978  64  -10.2144   -34  59        u=64  imp:n=1  vol=78.9937  $ fuel
979  4  -1.785E-4   34 -35  59     u=64  imp:n=1   $ gap
980  2  -6.74       35 -36  59     u=64  imp:n=1   $ clad
981  64  -10.2144   -37  59        u=64  imp:n=1  vol=78.9937  $ fuel
982  4  -1.785E-4   37 -38  59     u=64  imp:n=1   $ gap
983  2  -6.74       38 -39  59     u=64  imp:n=1   $ clad
984  64  -10.2144   -40  59        u=64  imp:n=1  vol=78.9937  $ fuel
985  4  -1.785E-4   40 -41  59     u=64  imp:n=1   $ gap
986  2  -6.74       41 -42  59     u=64  imp:n=1   $ clad
987  64  -10.2144   -43  59        u=64  imp:n=1  vol=78.9937  $ fuel
988  4  -1.785E-4   43 -44  59     u=64  imp:n=1   $ gap
989  2  -6.74       44 -45  59     u=64  imp:n=1   $ clad
990  64  -10.2144   -46  59        u=64  imp:n=1  vol=78.9937  $ fuel
991  4  -1.785E-4   46 -47  59     u=64  imp:n=1   $ gap
992  2  -6.74       47 -48  59     u=64  imp:n=1   $ clad
993  64  -10.2144   -49  59        u=64  imp:n=1  vol=78.9937  $ fuel
994  4  -1.785E-4   49 -50  59     u=64  imp:n=1   $ gap
995  2  -6.74       50 -51  59     u=64  imp:n=1   $ clad
996  64  -10.2144   -52  59        u=64  imp:n=1  vol=78.9937  $ fuel
997  4  -1.785E-4   52 -53  59     u=64  imp:n=1   $ gap
998  2  -6.74       53 -54  59     u=64  imp:n=1   $ clad
999  64  -10.2144   -55  59        u=64  imp:n=1  vol=78.9937  $ fuel
1000  4  -1.785E-4   55 -56  59     u=64  imp:n=1   $ gap
1001 2  -6.74       56 -57  59     u=64  imp:n=1   $ clad
1002  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=64  imp:n=1    $ D2O coolant
1003  3  -0.8143    -59 -60         u=64  imp:n=1    $ spacer
C      ************************************************************
1004   71  -10.2144   -1  59         u=71  imp:n=1  vol=78.9937  $ fuel
1005   4  -1.785E-4   1 -2  59       u=71  imp:n=1   $ gap
1006   2  -6.74       2 -3  59       u=71  imp:n=1   $ clad
```

```
1007   71  -10.2144   -4  59         u=71  imp:n=1  vol=78.9937  $ fuel
1008   4  -1.785E-4   4 -5  59       u=71  imp:n=1   $ gap
1009   2  -6.74       5 -6  59       u=71  imp:n=1   $ clad
1010   71  -10.2144   -7  59         u=71  imp:n=1  vol=78.9937  $ fuel
1011   4  -1.785E-4   7 -8  59       u=71  imp:n=1   $ gap
1012   2  -6.74       8 -9  59       u=71  imp:n=1   $ clad
1013  71  -10.2144   -10   59       u=71  imp:n=1  vol=78.9937  $ fuel
1014  4  -1.785E-4   10 -11  59     u=71  imp:n=1   $ gap
1015  2  -6.74       11 -12  59     u=71  imp:n=1   $ clad
1016  71  -10.2144   -13  59        u=71  imp:n=1  vol=78.9937  $ fuel
1017  4  -1.785E-4   13 -14  59     u=71  imp:n=1   $ gap
1018  2  -6.74       14 -15  59     u=71  imp:n=1   $ clad
1019  71  -10.2144   -16  59        u=71  imp:n=1  vol=78.9937  $ fuel
1020  4  -1.785E-4   16 -17  59     u=71  imp:n=1   $ gap
1021  2  -6.74       17 -18  59     u=71  imp:n=1   $ clad
1022  71  -10.2144   -19  59        u=71  imp:n=1  vol=78.9937  $ fuel
1023  4  -1.785E-4   19 -20  59     u=71  imp:n=1   $ gap
1024  2  -6.74       20 -21  59     u=71  imp:n=1   $ clad
1025  71  -10.2144   -22  59        u=71  imp:n=1  vol=78.9937  $ fuel
1026  4  -1.785E-4   22 -23  59     u=71  imp:n=1   $ gap
1027  2  -6.74       23 -24  59     u=71  imp:n=1   $ clad
1028  71  -10.2144   -25  59        u=71  imp:n=1  vol=78.9937  $ fuel
1029  4  -1.785E-4   25 -26  59     u=71  imp:n=1   $ gap
1030  2  -6.74       26 -27  59     u=71  imp:n=1   $ clad
1031  71  -10.2144   -28  59        u=71  imp:n=1  vol=78.9937  $ fuel
1032  4  -1.785E-4   28 -29  59     u=71  imp:n=1   $ gap
1033  2  -6.74       29 -30  59     u=71  imp:n=1   $ clad
1034  71  -10.2144   -31  59        u=71  imp:n=1  vol=78.9937  $ fuel
1035  4  -1.785E-4   31 -32  59     u=71  imp:n=1   $ gap
1036  2  -6.74       32 -33  59     u=71  imp:n=1   $ clad
1037  71  -10.2144   -34  59        u=71  imp:n=1  vol=78.9937  $ fuel
1038  4  -1.785E-4   34 -35  59     u=71  imp:n=1   $ gap
1039  2  -6.74       35 -36  59     u=71  imp:n=1   $ clad
1040  71 -10.2144   -37  59         u=71  imp:n=1  vol=78.9937  $ fuel
1041  4  -1.785E-4   37 -38  59     u=71  imp:n=1   $ gap
1042  2  -6.74       38 -39  59     u=71  imp:n=1   $ clad
1043  71  -10.2144   -40  59        u=71  imp:n=1  vol=78.9937  $ fuel
1044  4  -1.785E-4   40 -41  59     u=71  imp:n=1   $ gap
1045  2  -6.74       41 -42  59     u=71  imp:n=1   $ clad
1046  71  -10.2144   -43  59        u=71  imp:n=1  vol=78.9937  $ fuel
1047  4  -1.785E-4   43 -44  59     u=71  imp:n=1   $ gap
1048  2  -6.74       44 -45  59     u=71  imp:n=1   $ clad
1049  71  -10.2144   -46  59        u=71  imp:n=1  vol=78.9937  $ fuel
1050  4  -1.785E-4   46 -47  59     u=71  imp:n=1   $ gap
1051  2  -6.74       47 -48  59     u=71  imp:n=1   $ clad
1052  71  -10.2144   -49  59        u=71  imp:n=1  vol=78.9937  $ fuel
1053  4  -1.785E-4   49 -50  59     u=71  imp:n=1   $ gap
1054  2  -6.74       50 -51  59     u=71  imp:n=1   $ clad
1055  71  -10.2144   -52  59        u=71  imp:n=1  vol=78.9937  $ fuel
1056  4  -1.785E-4   52 -53  59     u=71  imp:n=1   $ gap
1057  2  -6.74       53 -54  59     u=71  imp:n=1   $ clad
1058  71  -10.2144   -55  59        u=71  imp:n=1  vol=78.9937  $ fuel
1059  4  -1.785E-4   55 -56  59     u=71  imp:n=1   $ gap
1060  2  -6.74       56 -57  59     u=71  imp:n=1   $ clad
1061  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
```

```
                      (-60 59)     u=71  imp:n=1    $ D2O coolant
1062  3  -0.8143    -59 -60          u=71  imp:n=1    $ spacer
C      ********************************************************************
1063   72  -10.2144   -1  59          u=72  imp:n=1  vol=78.9937  $ fuel
1064   4  -1.785E-4   1 -2  59       u=72  imp:n=1   $ gap
1065   2  -6.74       2 -3  59       u=72  imp:n=1   $ clad
1066   72  -10.2144   -4  59         u=72  imp:n=1  vol=78.9937  $ fuel
1067   4  -1.785E-4   4 -5  59       u=72  imp:n=1   $ gap
1068   2  -6.74       5 -6  59       u=72  imp:n=1   $ clad
1069   72  -10.2144   -7  59         u=72  imp:n=1  vol=78.9937  $ fuel
1070   4  -1.785E-4   7 -8  59       u=72  imp:n=1   $ gap
1071   2  -6.74       8 -9  59       u=72  imp:n=1   $ clad
1072  72  -10.2144   -10   59       u=72  imp:n=1  vol=78.9937  $ fuel
1073  4  -1.785E-4   10 -11  59     u=72  imp:n=1   $ gap
1074  2  -6.74       11 -12  59     u=72  imp:n=1   $ clad
1075  72  -10.2144   -13  59        u=72  imp:n=1  vol=78.9937  $ fuel
1076  4  -1.785E-4   13 -14  59     u=72  imp:n=1   $ gap
1077  2  -6.74       14 -15  59     u=72  imp:n=1   $ clad
1078  72  -10.2144   -16  59        u=72  imp:n=1  vol=78.9937  $ fuel
1079  4  -1.785E-4   16 -17  59     u=72  imp:n=1   $ gap
1080  2  -6.74       17 -18  59     u=72  imp:n=1   $ clad
1081  72  -10.2144   -19  59        u=72  imp:n=1  vol=78.9937  $ fuel
1082  4  -1.785E-4   19 -20  59     u=72  imp:n=1   $ gap
1083  2  -6.74       20 -21  59     u=72  imp:n=1   $ clad
1084  72  -10.2144   -22  59        u=72  imp:n=1  vol=78.9937  $ fuel
1085  4  -1.785E-4   22 -23  59     u=72  imp:n=1   $ gap
1086  2  -6.74       23 -24  59     u=72  imp:n=1   $ clad
1087  72  -10.2144   -25  59        u=72  imp:n=1  vol=78.9937  $ fuel
1088  4  -1.785E-4   25 -26  59     u=72  imp:n=1   $ gap
1089  2  -6.74       26 -27  59     u=72  imp:n=1   $ clad
1090  72  -10.2144   -28  59        u=72  imp:n=1  vol=78.9937  $ fuel
1091  4  -1.785E-4   28 -29  59     u=72  imp:n=1   $ gap
1092  2  -6.74       29 -30  59     u=72  imp:n=1   $ clad
1093  72  -10.2144   -31  59        u=72  imp:n=1  vol=78.9937  $ fuel
1094  4  -1.785E-4   31 -32  59     u=72  imp:n=1   $ gap
1095  2  -6.74       32 -33  59     u=72  imp:n=1   $ clad
1096  72  -10.2144   -34  59        u=72  imp:n=1  vol=78.9937  $ fuel
1097  4  -1.785E-4   34 -35  59     u=72  imp:n=1   $ gap
1098  2  -6.74       35 -36  59     u=72  imp:n=1   $ clad
1099  72  -10.2144   -37  59        u=72  imp:n=1  vol=78.9937  $ fuel
1100  4  -1.785E-4   37 -38  59     u=72  imp:n=1   $ gap
1101  2  -6.74       38 -39  59     u=72  imp:n=1   $ clad
1102  72  -10.2144   -40  59        u=72  imp:n=1  vol=78.9937  $ fuel
1103  4  -1.785E-4   40 -41  59     u=72  imp:n=1   $ gap
1104  2  -6.74       41 -42  59     u=72  imp:n=1   $ clad
1105  72  -10.2144   -43  59        u=72  imp:n=1  vol=78.9937  $ fuel
1106  4  -1.785E-4   43 -44  59     u=72  imp:n=1   $ gap
1107  2  -6.74       44 -45  59     u=72  imp:n=1   $ clad
1108  72  -10.2144   -46  59        u=72  imp:n=1  vol=78.9937  $ fuel
1109  4  -1.785E-4   46 -47  59     u=72  imp:n=1   $ gap
1110  2  -6.74       47 -48  59     u=72  imp:n=1   $ clad
1111  72  -10.2144   -49  59        u=72  imp:n=1  vol=78.9937  $ fuel
1112  4  -1.785E-4   49 -50  59     u=72  imp:n=1   $ gap
1113  2  -6.74       50 -51  59     u=72  imp:n=1   $ clad
1114  72  -10.2144   -52  59        u=72  imp:n=1  vol=78.9937  $ fuel
```

```
1115  4  -1.785E-4   52 -53  59     u=72  imp:n=1   $ gap
1116  2  -6.74       53 -54  59     u=72  imp:n=1   $ clad
1117  72  -10.2144   -55  59        u=72  imp:n=1  vol=78.9937  $ fuel
1118  4  -1.785E-4   55 -56  59     u=72  imp:n=1   $ gap
1119  2  -6.74       56 -57  59     u=72  imp:n=1   $ clad
1120  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=72  imp:n=1    $ D2O coolant
1121  3  -0.8143    -59 -60          u=72  imp:n=1    $ spacer
C      ********************************************************************
1122   74  -10.2144   -1  59         u=74  imp:n=1  vol=78.9937  $ fuel
1123   4  -1.785E-4   1 -2  59       u=74  imp:n=1   $ gap
1124   2  -6.74       2 -3  59       u=74  imp:n=1   $ clad
1125   74  -10.2144   -4  59        u=74  imp:n=1  vol=78.9937  $ fuel
1126   4  -1.785E-4   4 -5  59       u=74  imp:n=1   $ gap
1127   2  -6.74       5 -6  59       u=74  imp:n=1   $ clad
1128   74  -10.2144   -7  59        u=74  imp:n=1  vol=78.9937  $ fuel
1129   4  -1.785E-4   7 -8  59       u=74  imp:n=1   $ gap
1130   2  -6.74       8 -9  59       u=74  imp:n=1   $ clad
1131  74  -10.2144   -10   59       u=74  imp:n=1  vol=78.9937  $ fuel
1132  4  -1.785E-4   10 -11  59     u=74  imp:n=1   $ gap
1133  2  -6.74       11 -12  59     u=74  imp:n=1   $ clad
1134  74  -10.2144   -13  59        u=74  imp:n=1  vol=78.9937  $ fuel
1135  4  -1.785E-4   13 -14  59     u=74  imp:n=1   $ gap
1136  2  -6.74       14 -15  59     u=74  imp:n=1   $ clad
1137  74  -10.2144   -16  59        u=74  imp:n=1  vol=78.9937  $ fuel
1138  4  -1.785E-4   16 -17  59     u=74  imp:n=1   $ gap
1139  2  -6.74       17 -18  59     u=74  imp:n=1   $ clad
1140  74  -10.2144   -19  59        u=74  imp:n=1  vol=78.9937  $ fuel
1141  4  -1.785E-4   19 -20  59     u=74  imp:n=1   $ gap
1142  2  -6.74       20 -21  59     u=74  imp:n=1   $ clad
1143  74  -10.2144   -22  59        u=74  imp:n=1  vol=78.9937  $ fuel
1144  4  -1.785E-4   22 -23  59     u=74  imp:n=1   $ gap
1145  2  -6.74       23 -24  59     u=74  imp:n=1   $ clad
1146  74  -10.2144   -25  59        u=74  imp:n=1  vol=78.9937  $ fuel
1147  4  -1.785E-4   25 -26  59     u=74  imp:n=1   $ gap
1148  2  -6.74       26 -27  59     u=74  imp:n=1   $ clad
1149  74  -10.2144   -28  59        u=74  imp:n=1  vol=78.9937  $ fuel
1150  4  -1.785E-4   28 -29  59     u=74  imp:n=1   $ gap
1151  2  -6.74       29 -30  59     u=74  imp:n=1   $ clad
1152  74  -10.2144   -31  59        u=74  imp:n=1  vol=78.9937  $ fuel
1153  4  -1.785E-4   31 -32  59     u=74  imp:n=1   $ gap
1154  2  -6.74       32 -33  59     u=74  imp:n=1   $ clad
1155  74  -10.2144   -34  59        u=74  imp:n=1  vol=78.9937  $ fuel
1156  4  -1.785E-4   34 -35  59     u=74  imp:n=1   $ gap
1157  2  -6.74       35 -36  59     u=74  imp:n=1   $ clad
1158  74 -10.2144   -37  59        u=74  imp:n=1  vol=78.9937  $ fuel
1159  4  -1.785E-4   37 -38  59     u=74  imp:n=1   $ gap
1160  2  -6.74       38 -39  59     u=74  imp:n=1   $ clad
1161  74  -10.2144   -40  59        u=74  imp:n=1  vol=78.9937  $ fuel
1162  4  -1.785E-4   40 -41  59     u=74  imp:n=1   $ gap
1163  2  -6.74       41 -42  59     u=74  imp:n=1   $ clad
1164  74  -10.2144   -43  59        u=74  imp:n=1  vol=78.9937  $ fuel
1165  4  -1.785E-4   43 -44  59     u=74  imp:n=1   $ gap
1166  2  -6.74       44 -45  59     u=74  imp:n=1   $ clad
1167  74  -10.2144   -46  59        u=74  imp:n=1  vol=78.9937  $ fuel
```

```
1168  4  -1.785E-4   46 -47  59     u=74  imp:n=1   $ gap
1169  2  -6.74       47 -48  59     u=74  imp:n=1   $ clad
1170  74  -10.2144   -49  59        u=74  imp:n=1  vol=78.9937  $ fuel
1171  4  -1.785E-4   49 -50  59     u=74  imp:n=1   $ gap
1172  2  -6.74       50 -51  59     u=74  imp:n=1   $ clad
1173  74  -10.2144   -52  59        u=74  imp:n=1  vol=78.9937  $ fuel
1174  4  -1.785E-4   52 -53  59     u=74  imp:n=1   $ gap
1175  2  -6.74       53 -54  59     u=74  imp:n=1   $ clad
1176  74  -10.2144   -55  59        u=74  imp:n=1  vol=78.9937  $ fuel
1177  4  -1.785E-4   55 -56  59     u=74  imp:n=1   $ gap
1178  2  -6.74       56 -57  59     u=74  imp:n=1   $ clad
1179  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=74  imp:n=1    $ D2O coolant
1180  3  -0.8143    -59 -60          u=74  imp:n=1    $ spacer
C      ************************************************************
1181   81  -10.2144   -1  59         u=81  imp:n=1  vol=78.9937  $ fuel
1182   4  -1.785E-4   1 -2  59       u=81  imp:n=1   $ gap
1183   2  -6.74       2 -3  59       u=81  imp:n=1   $ clad
1184   81  -10.2144   -4  59        u=81  imp:n=1  vol=78.9937  $ fuel
1185   4  -1.785E-4   4 -5  59       u=81  imp:n=1   $ gap
1186   2  -6.74       5 -6  59       u=81  imp:n=1   $ clad
1187   81  -10.2144   -7  59        u=81  imp:n=1  vol=78.9937  $ fuel
1188   4  -1.785E-4   7 -8  59       u=81  imp:n=1   $ gap
1189   2  -6.74       8 -9  59       u=81  imp:n=1   $ clad
1190  81  -10.2144   -10   59       u=81  imp:n=1  vol=78.9937  $ fuel
1191  4  -1.785E-4   10 -11  59     u=81  imp:n=1   $ gap
1192  2  -6.74       11 -12  59     u=81  imp:n=1   $ clad
1193  81  -10.2144   -13  59        u=81  imp:n=1  vol=78.9937  $ fuel
1194  4  -1.785E-4   13 -14  59     u=81  imp:n=1   $ gap
1195  2  -6.74       14 -15  59     u=81  imp:n=1   $ clad
1196  81  -10.2144   -16  59        u=81  imp:n=1  vol=78.9937  $ fuel
1197  4  -1.785E-4   16 -17  59     u=81  imp:n=1   $ gap
1198  2  -6.74       17 -18  59     u=81  imp:n=1   $ clad
1199  81  -10.2144   -19  59        u=81  imp:n=1  vol=78.9937  $ fuel
1200  4  -1.785E-4   19 -20  59     u=81  imp:n=1   $ gap
1201  2  -6.74       20 -21  59     u=81  imp:n=1   $ clad
1202  81  -10.2144   -22  59        u=81  imp:n=1  vol=78.9937  $ fuel
1203  4  -1.785E-4   22 -23  59     u=81  imp:n=1   $ gap
1204  2  -6.74       23 -24  59     u=81  imp:n=1   $ clad
1205  81  -10.2144   -25  59        u=81  imp:n=1  vol=78.9937  $ fuel
1206  4  -1.785E-4   25 -26  59     u=81  imp:n=1   $ gap
1207  2  -6.74       26 -27  59     u=81  imp:n=1   $ clad
1208  81  -10.2144   -28  59        u=81  imp:n=1  vol=78.9937  $ fuel
1209  4  -1.785E-4   28 -29  59     u=81  imp:n=1   $ gap
1210  2  -6.74       29 -30  59     u=81  imp:n=1   $ clad
1211  81  -10.2144   -31  59        u=81  imp:n=1  vol=78.9937  $ fuel
1212  4  -1.785E-4   31 -32  59     u=81  imp:n=1   $ gap
1213  2  -6.74       32 -33  59     u=81  imp:n=1   $ clad
1214  81  -10.2144   -34  59        u=81  imp:n=1  vol=78.9937  $ fuel
1215  4  -1.785E-4   34 -35  59     u=81  imp:n=1   $ gap
1216  2  -6.74       35 -36  59     u=81  imp:n=1   $ clad
1217  81  -10.2144   -37  59        u=81  imp:n=1  vol=78.9937  $ fuel
1218  4  -1.785E-4   37 -38  59     u=81  imp:n=1   $ gap
1219  2  -6.74       38 -39  59     u=81  imp:n=1   $ clad
1220  81  -10.2144   -40  59        u=81  imp:n=1  vol=78.9937  $ fuel
```

```
1221  4  -1.785E-4   40 -41  59     u=81  imp:n=1   $ gap
1222  2  -6.74       41 -42  59     u=81  imp:n=1   $ clad
1223  81  -10.2144   -43  59        u=81  imp:n=1  vol=78.9937  $ fuel
1224  4  -1.785E-4   43 -44  59     u=81  imp:n=1   $ gap
1225  2  -6.74       44 -45  59     u=81  imp:n=1   $ clad
1226  81  -10.2144   -46  59        u=81  imp:n=1  vol=78.9937  $ fuel
1227  4  -1.785E-4   46 -47  59     u=81  imp:n=1   $ gap
1228  2  -6.74       47 -48  59     u=81  imp:n=1   $ clad
1229  81  -10.2144   -49  59        u=81  imp:n=1  vol=78.9937  $ fuel
1230  4  -1.785E-4   49 -50  59     u=81  imp:n=1   $ gap
1231  2  -6.74       50 -51  59     u=81  imp:n=1   $ clad
1232  81  -10.2144   -52  59        u=81  imp:n=1  vol=78.9937  $ fuel
1233  4  -1.785E-4   52 -53  59     u=81  imp:n=1   $ gap
1234  2  -6.74       53 -54  59     u=81  imp:n=1   $ clad
1235  81  -10.2144   -55  59        u=81  imp:n=1  vol=78.9937  $ fuel
1236  4  -1.785E-4   55 -56  59     u=81  imp:n=1   $ gap
1237  2  -6.74       56 -57  59     u=81  imp:n=1   $ clad
1238  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=81  imp:n=1    $ D2O coolant
1239  3  -0.8143    -59 -60          u=81  imp:n=1    $ spacer
C      ************************************************************
1240   82  -10.2144   -1  59          u=82  imp:n=1  vol=78.9937  $ fuel
1241   4  -1.785E-4   1 -2  59       u=82  imp:n=1   $ gap
1242   2  -6.74       2 -3  59       u=82  imp:n=1   $ clad
1243   82  -10.2144   -4  59        u=82  imp:n=1  vol=78.9937  $ fuel
1244   4  -1.785E-4   4 -5  59       u=82  imp:n=1   $ gap
1245   2  -6.74       5 -6  59       u=82  imp:n=1   $ clad
1246   82  -10.2144   -7  59        u=82  imp:n=1  vol=78.9937  $ fuel
1247   4  -1.785E-4   7 -8  59       u=82  imp:n=1   $ gap
1248   2  -6.74       8 -9  59       u=82  imp:n=1   $ clad
1249  82  -10.2144   -10   59       u=82  imp:n=1  vol=78.9937  $ fuel
1250  4  -1.785E-4   10 -11  59     u=82  imp:n=1   $ gap
1251  2  -6.74       11 -12  59     u=82  imp:n=1   $ clad
1252  82  -10.2144   -13  59        u=82  imp:n=1  vol=78.9937  $ fuel
1253  4  -1.785E-4   13 -14  59     u=82  imp:n=1   $ gap
1254  2  -6.74       14 -15  59     u=82  imp:n=1   $ clad
1255  82  -10.2144   -16  59        u=82  imp:n=1  vol=78.9937  $ fuel
1256  4  -1.785E-4   16 -17  59     u=82  imp:n=1   $ gap
1257  2  -6.74       17 -18  59     u=82  imp:n=1   $ clad
1258  82  -10.2144   -19  59        u=82  imp:n=1  vol=78.9937  $ fuel
1259  4  -1.785E-4   19 -20  59     u=82  imp:n=1   $ gap
1260  2  -6.74       20 -21  59     u=82  imp:n=1   $ clad
1261  82  -10.2144   -22  59        u=82  imp:n=1  vol=78.9937  $ fuel
1262  4  -1.785E-4   22 -23  59     u=82  imp:n=1   $ gap
1263  2  -6.74       23 -24  59     u=82  imp:n=1   $ clad
1264  82  -10.2144   -25  59        u=82  imp:n=1  vol=78.9937  $ fuel
1265  4  -1.785E-4   25 -26  59     u=82  imp:n=1   $ gap
1266  2  -6.74       26 -27  59     u=82  imp:n=1   $ clad
1267  82  -10.2144   -28  59        u=82  imp:n=1  vol=78.9937  $ fuel
1268  4  -1.785E-4   28 -29  59     u=82  imp:n=1   $ gap
1269  2  -6.74       29 -30  59     u=82  imp:n=1   $ clad
1270  82  -10.2144   -31  59        u=82  imp:n=1  vol=78.9937  $ fuel
1271  4  -1.785E-4   31 -32  59     u=82  imp:n=1   $ gap
1272  2  -6.74       32 -33  59     u=82  imp:n=1   $ clad
1273  82  -10.2144   -34  59        u=82  imp:n=1  vol=78.9937  $ fuel
```

```
1274  4  -1.785E-4   34 -35  59     u=82  imp:n=1   $ gap
1275  2  -6.74       35 -36  59     u=82  imp:n=1   $ clad
1276  82  -10.2144   -37  59        u=82  imp:n=1  vol=78.9937  $ fuel
1277  4  -1.785E-4   37 -38  59     u=82  imp:n=1   $ gap
1278  2  -6.74       38 -39  59     u=82  imp:n=1   $ clad
1279  82  -10.2144   -40  59        u=82  imp:n=1  vol=78.9937  $ fuel
1280  4  -1.785E-4   40 -41  59     u=82  imp:n=1   $ gap
1281  2  -6.74       41 -42  59     u=82  imp:n=1   $ clad
1282  82  -10.2144   -43  59        u=82  imp:n=1  vol=78.9937  $ fuel
1283  4  -1.785E-4   43 -44  59     u=82  imp:n=1   $ gap
1284  2  -6.74       44 -45  59     u=82  imp:n=1   $ clad
1285  82  -10.2144   -46  59        u=82  imp:n=1  vol=78.9937  $ fuel
1286  4  -1.785E-4   46 -47  59     u=82  imp:n=1   $ gap
1287  2  -6.74       47 -48  59     u=82  imp:n=1   $ clad
1288  82  -10.2144   -49  59        u=82  imp:n=1  vol=78.9937  $ fuel
1289  4  -1.785E-4   49 -50  59     u=82  imp:n=1   $ gap
1290  2  -6.74       50 -51  59     u=82  imp:n=1   $ clad
1291  82  -10.2144   -52  59        u=82  imp:n=1  vol=78.9937  $ fuel
1292  4  -1.785E-4   52 -53  59     u=82  imp:n=1   $ gap
1293  2  -6.74       53 -54  59     u=82  imp:n=1   $ clad
1294  82  -10.2144   -55  59        u=82  imp:n=1  vol=78.9937  $ fuel
1295  4  -1.785E-4   55 -56  59     u=82  imp:n=1   $ gap
1296  2  -6.74       56 -57  59     u=82  imp:n=1   $ clad
1297  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=82  imp:n=1    $ D2O coolant
1298  3  -0.8143    -59 -60          u=82  imp:n=1    $ spacer
C      ***************************************************************
1299   84  -10.2144   -1  59         u=84  imp:n=1  vol=78.9937  $ fuel
1300   4  -1.785E-4   1 -2  59       u=84  imp:n=1   $ gap
1301   2  -6.74       2 -3  59       u=84  imp:n=1   $ clad
1302   84  -10.2144   -4  59        u=84  imp:n=1  vol=78.9937  $ fuel
1303   4  -1.785E-4   4 -5  59       u=84  imp:n=1   $ gap
1304   2  -6.74       5 -6  59       u=84  imp:n=1   $ clad
1305   84  -10.2144   -7  59        u=84  imp:n=1  vol=78.9937  $ fuel
1306   4  -1.785E-4   7 -8  59       u=84  imp:n=1   $ gap
1307   2  -6.74       8 -9  59       u=84  imp:n=1   $ clad
1308  84  -10.2144   -10   59       u=84  imp:n=1  vol=78.9937  $ fuel
1309  4  -1.785E-4   10 -11  59     u=84  imp:n=1   $ gap
1310  2  -6.74       11 -12  59     u=84  imp:n=1   $ clad
1311  84  -10.2144   -13  59        u=84  imp:n=1  vol=78.9937  $ fuel
1312  4  -1.785E-4   13 -14  59     u=84  imp:n=1   $ gap
1313  2  -6.74       14 -15  59     u=84  imp:n=1   $ clad
1314  84  -10.2144   -16  59        u=84  imp:n=1  vol=78.9937  $ fuel
1315  4  -1.785E-4   16 -17  59     u=84  imp:n=1   $ gap
1316  2  -6.74       17 -18  59     u=84  imp:n=1   $ clad
1317  84  -10.2144   -19  59        u=84  imp:n=1  vol=78.9937  $ fuel
1318  4  -1.785E-4   19 -20  59     u=84  imp:n=1   $ gap
1319  2  -6.74       20 -21  59     u=84  imp:n=1   $ clad
1320  84  -10.2144   -22  59        u=84  imp:n=1  vol=78.9937  $ fuel
1321  4  -1.785E-4   22 -23  59     u=84  imp:n=1   $ gap
1322  2  -6.74       23 -24  59     u=84  imp:n=1   $ clad
1323  84  -10.2144   -25  59        u=84  imp:n=1  vol=78.9937  $ fuel
1324  4  -1.785E-4   25 -26  59     u=84  imp:n=1   $ gap
1325  2  -6.74       26 -27  59     u=84  imp:n=1   $ clad
1326  84  -10.2144   -28  59        u=84  imp:n=1  vol=78.9937  $ fuel
```

```
1327  4  -1.785E-4   28 -29  59     u=84  imp:n=1   $ gap
1328  2  -6.74       29 -30  59     u=84  imp:n=1   $ clad
1329  84  -10.2144   -31  59        u=84  imp:n=1  vol=78.9937  $ fuel
1330  4  -1.785E-4   31 -32  59     u=84  imp:n=1   $ gap
1331  2  -6.74       32 -33  59     u=84  imp:n=1   $ clad
1332  84  -10.2144   -34  59        u=84  imp:n=1  vol=78.9937  $ fuel
1333  4  -1.785E-4   34 -35  59     u=84  imp:n=1   $ gap
1334  2  -6.74       35 -36  59     u=84  imp:n=1   $ clad
1335  84  -10.2144   -37  59        u=84  imp:n=1  vol=78.9937  $ fuel
1336  4  -1.785E-4   37 -38  59     u=84  imp:n=1   $ gap
1337  2  -6.74       38 -39  59     u=84  imp:n=1   $ clad
1338  84  -10.2144   -40  59        u=84  imp:n=1  vol=78.9937  $ fuel
1339  4  -1.785E-4   40 -41  59     u=84  imp:n=1   $ gap
1340  2  -6.74       41 -42  59     u=84  imp:n=1   $ clad
1341  84  -10.2144   -43  59        u=84  imp:n=1  vol=78.9937  $ fuel
1342  4  -1.785E-4   43 -44  59     u=84  imp:n=1   $ gap
1343  2  -6.74       44 -45  59     u=84  imp:n=1   $ clad
1344  84  -10.2144   -46  59        u=84  imp:n=1  vol=78.9937  $ fuel
1345  4  -1.785E-4   46 -47  59     u=84  imp:n=1   $ gap
1346  2  -6.74       47 -48  59     u=84  imp:n=1   $ clad
1347  84  -10.2144   -49  59        u=84  imp:n=1  vol=78.9937  $ fuel
1348  4  -1.785E-4   49 -50  59     u=84  imp:n=1   $ gap
1349  2  -6.74       50 -51  59     u=84  imp:n=1   $ clad
1350  84  -10.2144   -52  59        u=84  imp:n=1  vol=78.9937  $ fuel
1351  4  -1.785E-4   52 -53  59     u=84  imp:n=1   $ gap
1352  2  -6.74       53 -54  59     u=84  imp:n=1   $ clad
1353  84  -10.2144   -55  59        u=84  imp:n=1  vol=78.9937  $ fuel
1354  4  -1.785E-4   55 -56  59     u=84  imp:n=1   $ gap
1355  2  -6.74       56 -57  59     u=84  imp:n=1   $ clad
1356  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=84  imp:n=1    $ D2O coolant
1357  3  -0.8143    -59 -60          u=84  imp:n=1    $ spacer
C      ************************************************************
1358   91  -10.2144   -1  59         u=91  imp:n=1  vol=78.9937  $ fuel
1359   4  -1.785E-4   1 -2  59       u=91  imp:n=1   $ gap
1360   2  -6.74       2 -3  59       u=91  imp:n=1   $ clad
1361   91  -10.2144   -4  59         u=91  imp:n=1  vol=78.9937  $ fuel
1362   4  -1.785E-4   4 -5  59       u=91  imp:n=1   $ gap
1363   2  -6.74       5 -6  59       u=91  imp:n=1   $ clad
1364   91  -10.2144   -7  59         u=91  imp:n=1  vol=78.9937  $ fuel
1365   4  -1.785E-4   7 -8  59       u=91  imp:n=1   $ gap
1366   2  -6.74       8 -9  59       u=91  imp:n=1   $ clad
1367  91  -10.2144   -10   59       u=91  imp:n=1  vol=78.9937  $ fuel
1368  4  -1.785E-4   10 -11  59     u=91  imp:n=1   $ gap
1369  2  -6.74       11 -12  59     u=91  imp:n=1   $ clad
1370  91  -10.2144   -13  59        u=91  imp:n=1  vol=78.9937  $ fuel
1371  4  -1.785E-4   13 -14  59     u=91  imp:n=1   $ gap
1372  2  -6.74       14 -15  59     u=91  imp:n=1   $ clad
1373  91  -10.2144   -16  59        u=91  imp:n=1  vol=78.9937  $ fuel
1374  4  -1.785E-4   16 -17  59     u=91  imp:n=1   $ gap
1375  2  -6.74       17 -18  59     u=91  imp:n=1   $ clad
1376  91  -10.2144   -19  59        u=91  imp:n=1  vol=78.9937  $ fuel
1377  4  -1.785E-4   19 -20  59     u=91  imp:n=1   $ gap
1378  2  -6.74       20 -21  59     u=91  imp:n=1   $ clad
1379  91  -10.2144   -22  59        u=91  imp:n=1  vol=78.9937  $ fuel
```

```
1380  4  -1.785E-4   22 -23  59     u=91  imp:n=1   $ gap
1381  2  -6.74       23 -24  59     u=91  imp:n=1   $ clad
1382  91  -10.2144   -25  59        u=91  imp:n=1  vol=78.9937  $ fuel
1383  4  -1.785E-4   25 -26  59     u=91  imp:n=1   $ gap
1384  2  -6.74       26 -27  59     u=91  imp:n=1   $ clad
1385  91  -10.2144   -28  59        u=91  imp:n=1  vol=78.9937  $ fuel
1386  4  -1.785E-4   28 -29  59     u=91  imp:n=1   $ gap
1387  2  -6.74       29 -30  59     u=91  imp:n=1   $ clad
1388  91  -10.2144   -31  59        u=91  imp:n=1  vol=78.9937  $ fuel
1389  4  -1.785E-4   31 -32  59     u=91  imp:n=1   $ gap
1390  2  -6.74       32 -33  59     u=91  imp:n=1   $ clad
1391  91  -10.2144   -34  59        u=91  imp:n=1  vol=78.9937  $ fuel
1392  4  -1.785E-4   34 -35  59     u=91  imp:n=1   $ gap
1393  2  -6.74       35 -36  59     u=91  imp:n=1   $ clad
1394  91  -10.2144   -37  59        u=91  imp:n=1  vol=78.9937  $ fuel
1395  4  -1.785E-4   37 -38  59     u=91  imp:n=1   $ gap
1396  2  -6.74       38 -39  59     u=91  imp:n=1   $ clad
1397  91  -10.2144   -40  59        u=91  imp:n=1  vol=78.9937  $ fuel
1398  4  -1.785E-4   40 -41  59     u=91  imp:n=1   $ gap
1399  2  -6.74       41 -42  59     u=91  imp:n=1   $ clad
1400  91  -10.2144   -43  59        u=91  imp:n=1  vol=78.9937  $ fuel
1401  4  -1.785E-4   43 -44  59     u=91  imp:n=1   $ gap
1402  2  -6.74       44 -45  59     u=91  imp:n=1   $ clad
1403  91  -10.2144   -46  59        u=91  imp:n=1  vol=78.9937  $ fuel
1404  4  -1.785E-4   46 -47  59     u=91  imp:n=1   $ gap
1405  2  -6.74       47 -48  59     u=91  imp:n=1   $ clad
1406  91  -10.2144   -49  59        u=91  imp:n=1  vol=78.9937  $ fuel
1407  4  -1.785E-4   49 -50  59     u=91  imp:n=1   $ gap
1408  2  -6.74       50 -51  59     u=91  imp:n=1   $ clad
1409  91  -10.2144   -52  59        u=91  imp:n=1  vol=78.9937  $ fuel
1410  4  -1.785E-4   52 -53  59     u=91  imp:n=1   $ gap
1411  2  -6.74       53 -54  59     u=91  imp:n=1   $ clad
1412  91  -10.2144   -55  59        u=91  imp:n=1  vol=78.9937  $ fuel
1413  4  -1.785E-4   55 -56  59     u=91  imp:n=1   $ gap
1414  2  -6.74       56 -57  59     u=91  imp:n=1   $ clad
1415  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=91  imp:n=1    $ D2O coolant
1416  3  -0.8143    -59 -60          u=91  imp:n=1    $ spacer
C      ***************************************************************
1417   92  -10.2144   -1  59          u=92  imp:n=1  vol=78.9937  $ fuel
1418   4  -1.785E-4   1 -2  59       u=92  imp:n=1   $ gap
1419   2  -6.74       2 -3  59       u=92  imp:n=1   $ clad
1420   92  -10.2144   -4  59        u=92  imp:n=1  vol=78.9937  $ fuel
1421   4  -1.785E-4   4 -5  59       u=92  imp:n=1   $ gap
1422   2  -6.74       5 -6  59       u=92  imp:n=1   $ clad
1423   92  -10.2144   -7  59        u=92  imp:n=1  vol=78.9937  $ fuel
1424   4  -1.785E-4   7 -8  59       u=92  imp:n=1   $ gap
1425   2  -6.74       8 -9  59       u=92  imp:n=1   $ clad
1426  92  -10.2144   -10   59       u=92  imp:n=1  vol=78.9937  $ fuel
1427  4  -1.785E-4   10 -11  59     u=92  imp:n=1   $ gap
1428  2  -6.74       11 -12  59     u=92  imp:n=1   $ clad
1429  92  -10.2144   -13  59        u=92  imp:n=1  vol=78.9937  $ fuel
1430  4  -1.785E-4   13 -14  59     u=92  imp:n=1   $ gap
1431  2  -6.74       14 -15  59     u=92  imp:n=1   $ clad
1432  92  -10.2144   -16  59        u=92  imp:n=1  vol=78.9937  $ fuel
```

```
1433  4  -1.785E-4   16 -17  59     u=92  imp:n=1   $ gap
1434  2  -6.74       17 -18  59     u=92  imp:n=1   $ clad
1435  92  -10.2144   -19  59        u=92  imp:n=1  vol=78.9937  $ fuel
1436  4  -1.785E-4   19 -20  59     u=92  imp:n=1   $ gap
1437  2  -6.74       20 -21  59     u=92  imp:n=1   $ clad
1438  92  -10.2144   -22  59        u=92  imp:n=1  vol=78.9937  $ fuel
1439  4  -1.785E-4   22 -23  59     u=92  imp:n=1   $ gap
1440  2  -6.74       23 -24  59     u=92  imp:n=1   $ clad
1441  92  -10.2144   -25  59        u=92  imp:n=1  vol=78.9937  $ fuel
1442  4  -1.785E-4   25 -26  59     u=92  imp:n=1   $ gap
1443  2  -6.74       26 -27  59     u=92  imp:n=1   $ clad
1444  92  -10.2144   -28  59        u=92  imp:n=1  vol=78.9937  $ fuel
1445  4  -1.785E-4   28 -29  59     u=92  imp:n=1   $ gap
1446  2  -6.74       29 -30  59     u=92  imp:n=1   $ clad
1447  92  -10.2144   -31  59        u=92  imp:n=1  vol=78.9937  $ fuel
1448  4  -1.785E-4   31 -32  59     u=92  imp:n=1   $ gap
1449  2  -6.74       32 -33  59     u=92  imp:n=1   $ clad
1450  92  -10.2144   -34  59        u=92  imp:n=1  vol=78.9937  $ fuel
1451  4  -1.785E-4   34 -35  59     u=92  imp:n=1   $ gap
1452  2  -6.74       35 -36  59     u=92  imp:n=1   $ clad
1453  92  -10.2144   -37  59        u=92  imp:n=1  vol=78.9937  $ fuel
1454  4  -1.785E-4   37 -38  59     u=92  imp:n=1   $ gap
1455  2  -6.74       38 -39  59     u=92  imp:n=1   $ clad
1456  92  -10.2144   -40  59        u=92  imp:n=1  vol=78.9937  $ fuel
1457  4  -1.785E-4   40 -41  59     u=92  imp:n=1   $ gap
1458  2  -6.74       41 -42  59     u=92  imp:n=1   $ clad
1459  92  -10.2144   -43  59        u=92  imp:n=1  vol=78.9937  $ fuel
1460  4  -1.785E-4   43 -44  59     u=92  imp:n=1   $ gap
1461  2  -6.74       44 -45  59     u=92  imp:n=1   $ clad
1462  92  -10.2144   -46  59        u=92  imp:n=1  vol=78.9937  $ fuel
1463  4  -1.785E-4   46 -47  59     u=92  imp:n=1   $ gap
1464  2  -6.74       47 -48  59     u=92  imp:n=1   $ clad
1465  92  -10.2144   -49  59        u=92  imp:n=1  vol=78.9937  $ fuel
1466  4  -1.785E-4   49 -50  59     u=92  imp:n=1   $ gap
1467  2  -6.74       50 -51  59     u=92  imp:n=1   $ clad
1468  92  -10.2144   -52  59        u=92  imp:n=1  vol=78.9937  $ fuel
1469  4  -1.785E-4   52 -53  59     u=92  imp:n=1   $ gap
1470  2  -6.74       53 -54  59     u=92  imp:n=1   $ clad
1471  92  -10.2144   -55  59        u=92  imp:n=1  vol=78.9937  $ fuel
1472  4  -1.785E-4   55 -56  59     u=92  imp:n=1   $ gap
1473  2  -6.74       56 -57  59     u=92  imp:n=1   $ clad
1474  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=92  imp:n=1    $ D2O coolant
1475  3  -0.8143    -59 -60          u=92  imp:n=1    $ spacer
C      ***************************************************************
1476   94  -10.2144   -1  59          u=94  imp:n=1  vol=78.9937  $ fuel
1477   4  -1.785E-4   1 -2  59       u=94  imp:n=1   $ gap
1478   2  -6.74       2 -3  59       u=94  imp:n=1   $ clad
1479   94  -10.2144   -4  59        u=94  imp:n=1  vol=78.9937  $ fuel
1480   4  -1.785E-4   4 -5  59       u=94  imp:n=1   $ gap
1481   2  -6.74       5 -6  59       u=94  imp:n=1   $ clad
1482   94  -10.2144   -7  59        u=94  imp:n=1  vol=78.9937  $ fuel
1483   4  -1.785E-4   7 -8  59       u=94  imp:n=1   $ gap
1484   2  -6.74       8 -9  59       u=94  imp:n=1   $ clad
1485  94  -10.2144   -10   59       u=94  imp:n=1  vol=78.9937  $ fuel
```

```
1486  4  -1.785E-4   10 -11  59     u=94  imp:n=1   $ gap
1487  2  -6.74       11 -12  59     u=94  imp:n=1   $ clad
1488  94  -10.2144   -13  59        u=94  imp:n=1  vol=78.9937  $ fuel
1489  4  -1.785E-4   13 -14  59     u=94  imp:n=1   $ gap
1490  2  -6.74       14 -15  59     u=94  imp:n=1   $ clad
1491  94  -10.2144   -16  59        u=94  imp:n=1  vol=78.9937  $ fuel
1492  4  -1.785E-4   16 -17  59     u=94  imp:n=1   $ gap
1493  2  -6.74       17 -18  59     u=94  imp:n=1   $ clad
1494  94  -10.2144   -19  59        u=94  imp:n=1  vol=78.9937  $ fuel
1495  4  -1.785E-4   19 -20  59     u=94  imp:n=1   $ gap
1496  2  -6.74       20 -21  59     u=94  imp:n=1   $ clad
1497  94  -10.2144   -22  59        u=94  imp:n=1  vol=78.9937  $ fuel
1498  4  -1.785E-4   22 -23  59     u=94  imp:n=1   $ gap
1499  2  -6.74       23 -24  59     u=94  imp:n=1   $ clad
1500  94  -10.2144   -25  59        u=94  imp:n=1  vol=78.9937  $ fuel
1501  4  -1.785E-4   25 -26  59     u=94  imp:n=1   $ gap
1502  2  -6.74       26 -27  59     u=94  imp:n=1   $ clad
1503  94  -10.2144   -28  59        u=94  imp:n=1  vol=78.9937  $ fuel
1504  4  -1.785E-4   28 -29  59     u=94  imp:n=1   $ gap
1505  2  -6.74       29 -30  59     u=94  imp:n=1   $ clad
1506  94  -10.2144   -31  59        u=94  imp:n=1  vol=78.9937  $ fuel
1507  4  -1.785E-4   31 -32  59     u=94  imp:n=1   $ gap
1508  2  -6.74       32 -33  59     u=94  imp:n=1   $ clad
1509  94  -10.2144   -34  59        u=94  imp:n=1  vol=78.9937  $ fuel
1510  4  -1.785E-4   34 -35  59     u=94  imp:n=1   $ gap
1511  2  -6.74       35 -36  59     u=94  imp:n=1   $ clad
1512  94  -10.2144   -37  59        u=94  imp:n=1  vol=78.9937  $ fuel
1513  4  -1.785E-4   37 -38  59     u=94  imp:n=1   $ gap
1514  2  -6.74       38 -39  59     u=94  imp:n=1   $ clad
1515  94  -10.2144   -40  59        u=94  imp:n=1  vol=78.9937  $ fuel
1516  4  -1.785E-4   40 -41  59     u=94  imp:n=1   $ gap
1517  2  -6.74       41 -42  59     u=94  imp:n=1   $ clad
1518  94  -10.2144   -43  59        u=94  imp:n=1  vol=78.9937  $ fuel
1519  4  -1.785E-4   43 -44  59     u=94  imp:n=1   $ gap
1520  2  -6.74       44 -45  59     u=94  imp:n=1   $ clad
1521  94  -10.2144   -46  59        u=94  imp:n=1  vol=78.9937  $ fuel
1522  4  -1.785E-4   46 -47  59     u=94  imp:n=1   $ gap
1523  2  -6.74       47 -48  59     u=94  imp:n=1   $ clad
1524  94  -10.2144   -49  59        u=94  imp:n=1  vol=78.9937  $ fuel
1525  4  -1.785E-4   49 -50  59     u=94  imp:n=1   $ gap
1526  2  -6.74       50 -51  59     u=94  imp:n=1   $ clad
1527  94  -10.2144   -52  59        u=94  imp:n=1  vol=78.9937  $ fuel
1528  4  -1.785E-4   52 -53  59     u=94  imp:n=1   $ gap
1529  2  -6.74       53 -54  59     u=94  imp:n=1   $ clad
1530  94  -10.2144   -55  59        u=94  imp:n=1  vol=78.9937  $ fuel
1531  4  -1.785E-4   55 -56  59     u=94  imp:n=1   $ gap
1532  2  -6.74       56 -57  59     u=94  imp:n=1   $ clad
1533  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=94  imp:n=1    $ D2O coolant
1534  3  -0.8143    -59 -60          u=94  imp:n=1    $ spacer
C      ****************************************************************
1535   101  -10.2144   -1  59          u=101  imp:n=1  vol=78.9937  $ fuel
1536   4  -1.785E-4   1 -2  59       u=101  imp:n=1   $ gap
1537   2  -6.74       2 -3  59       u=101  imp:n=1   $ clad
1538   101  -10.2144   -4  59        u=101  imp:n=1  vol=78.9937  $ fuel
```

```
1539   4  -1.785E-4   4 -5  59       u=101  imp:n=1   $ gap
1540   2  -6.74       5 -6  59       u=101  imp:n=1   $ clad
1541   101  -10.2144   -7  59        u=101  imp:n=1  vol=78.9937  $ fuel
1542   4  -1.785E-4   7 -8  59       u=101  imp:n=1   $ gap
1543   2  -6.74       8 -9  59       u=101  imp:n=1   $ clad
1544  101  -10.2144   -10   59      u=101  imp:n=1  vol=78.9937  $ fuel
1545  4  -1.785E-4   10 -11  59     u=101  imp:n=1   $ gap
1546  2  -6.74       11 -12  59     u=101  imp:n=1   $ clad
1547  101  -10.2144   -13  59       u=101  imp:n=1  vol=78.9937  $ fuel
1548  4  -1.785E-4   13 -14  59     u=101  imp:n=1   $ gap
1549  2  -6.74       14 -15  59     u=101  imp:n=1   $ clad
1550  101  -10.2144   -16  59       u=101  imp:n=1  vol=78.9937  $ fuel
1551  4  -1.785E-4   16 -17  59     u=101  imp:n=1   $ gap
1552  2  -6.74       17 -18  59     u=101  imp:n=1   $ clad
1553  101  -10.2144   -19  59       u=101  imp:n=1  vol=78.9937  $ fuel
1554  4  -1.785E-4   19 -20  59     u=101  imp:n=1   $ gap
1555  2  -6.74       20 -21  59     u=101  imp:n=1   $ clad
1556  101  -10.2144   -22  59       u=101  imp:n=1  vol=78.9937  $ fuel
1557  4  -1.785E-4   22 -23  59     u=101  imp:n=1   $ gap
1558  2  -6.74       23 -24  59     u=101  imp:n=1   $ clad
1559  101  -10.2144   -25  59       u=101  imp:n=1  vol=78.9937  $ fuel
1560  4  -1.785E-4   25 -26  59     u=101  imp:n=1   $ gap
1561  2  -6.74       26 -27  59     u=101  imp:n=1   $ clad
1562  101  -10.2144   -28  59       u=101  imp:n=1  vol=78.9937  $ fuel
1563  4  -1.785E-4   28 -29  59     u=101  imp:n=1   $ gap
1564  2  -6.74       29 -30  59     u=101  imp:n=1   $ clad
1565  101  -10.2144   -31  59       u=101  imp:n=1  vol=78.9937  $ fuel
1566  4  -1.785E-4   31 -32  59     u=101  imp:n=1   $ gap
1567  2  -6.74       32 -33  59     u=101  imp:n=1   $ clad
1568  101  -10.2144   -34  59       u=101  imp:n=1  vol=78.9937  $ fuel
1569  4  -1.785E-4   34 -35  59     u=101  imp:n=1   $ gap
1570  2  -6.74       35 -36  59     u=101  imp:n=1   $ clad
1571  101  -10.2144   -37  59       u=101  imp:n=1  vol=78.9937  $ fuel
1572  4  -1.785E-4   37 -38  59     u=101  imp:n=1   $ gap
1573  2  -6.74       38 -39  59     u=101  imp:n=1   $ clad
1574  101  -10.2144   -40  59       u=101  imp:n=1  vol=78.9937  $ fuel
1575  4  -1.785E-4   40 -41  59     u=101  imp:n=1   $ gap
1576  2  -6.74       41 -42  59     u=101  imp:n=1   $ clad
1577  101  -10.2144   -43  59       u=101  imp:n=1  vol=78.9937  $ fuel
1578  4  -1.785E-4   43 -44  59     u=101  imp:n=1   $ gap
1579  2  -6.74       44 -45  59     u=101  imp:n=1   $ clad
1580  101  -10.2144   -46  59       u=101  imp:n=1  vol=78.9937  $ fuel
1581  4  -1.785E-4   46 -47  59     u=101  imp:n=1   $ gap
1582  2  -6.74       47 -48  59     u=101  imp:n=1   $ clad
1583  101  -10.2144   -49  59       u=101  imp:n=1  vol=78.9937  $ fuel
1584  4  -1.785E-4   49 -50  59     u=101  imp:n=1   $ gap
1585  2  -6.74       50 -51  59     u=101  imp:n=1   $ clad
1586  101  -10.2144   -52  59       u=101  imp:n=1  vol=78.9937  $ fuel
1587  4  -1.785E-4   52 -53  59     u=101  imp:n=1   $ gap
1588  2  -6.74       53 -54  59     u=101  imp:n=1   $ clad
1589  101  -10.2144   -55  59       u=101  imp:n=1  vol=78.9937  $ fuel
1590  4  -1.785E-4   55 -56  59     u=101  imp:n=1   $ gap
1591  2  -6.74       56 -57  59     u=101  imp:n=1   $ clad
1592  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=101  imp:n=1    $ D2O coolant
```

```
1593  3  -0.8143    -59 -60           u=101  imp:n=1    $ spacer
C      ************************************************************
1594   102  -10.2144   -1  59          u=102  imp:n=1  vol=78.9937  $ fuel
1595   4  -1.785E-4   1 -2  59       u=102  imp:n=1   $ gap
1596   2  -6.74       2 -3  59       u=102  imp:n=1   $ clad
1597   102  -10.2144   -4  59        u=102  imp:n=1  vol=78.9937  $ fuel
1598   4  -1.785E-4   4 -5  59       u=102  imp:n=1   $ gap
1599   2  -6.74       5 -6  59       u=102  imp:n=1   $ clad
1600   102  -10.2144   -7  59        u=102  imp:n=1  vol=78.9937  $ fuel
1601   4  -1.785E-4   7 -8  59       u=102  imp:n=1   $ gap
1602   2  -6.74       8 -9  59       u=102  imp:n=1   $ clad
1603  102  -10.2144   -10   59      u=102  imp:n=1  vol=78.9937  $ fuel
1604  4  -1.785E-4   10 -11  59     u=102  imp:n=1   $ gap
1605  2  -6.74       11 -12  59     u=102  imp:n=1   $ clad
1606  102  -10.2144   -13  59       u=102  imp:n=1  vol=78.9937  $ fuel
1607  4  -1.785E-4   13 -14  59     u=102  imp:n=1   $ gap
1608  2  -6.74       14 -15  59     u=102  imp:n=1   $ clad
1609  102  -10.2144   -16  59       u=102  imp:n=1  vol=78.9937  $ fuel
1610  4  -1.785E-4   16 -17  59     u=102  imp:n=1   $ gap
1611  2  -6.74       17 -18  59     u=102  imp:n=1   $ clad
1612  102  -10.2144   -19  59       u=102  imp:n=1  vol=78.9937  $ fuel
1613  4  -1.785E-4   19 -20  59     u=102  imp:n=1   $ gap
1614  2  -6.74       20 -21  59     u=102  imp:n=1   $ clad
1615  102  -10.2144   -22  59       u=102  imp:n=1  vol=78.9937  $ fuel
1616  4  -1.785E-4   22 -23  59     u=102  imp:n=1   $ gap
1617  2  -6.74       23 -24  59     u=102  imp:n=1   $ clad
1618  102  -10.2144   -25  59       u=102  imp:n=1  vol=78.9937  $ fuel
1619  4  -1.785E-4   25 -26  59     u=102  imp:n=1   $ gap
1620  2  -6.74       26 -27  59     u=102  imp:n=1   $ clad
1621  102  -10.2144   -28  59       u=102  imp:n=1  vol=78.9937  $ fuel
1622  4  -1.785E-4   28 -29  59     u=102  imp:n=1   $ gap
1623  2  -6.74       29 -30  59     u=102  imp:n=1   $ clad
1624  102  -10.2144   -31  59       u=102  imp:n=1  vol=78.9937  $ fuel
1625  4  -1.785E-4   31 -32  59     u=102  imp:n=1   $ gap
1626  2  -6.74       32 -33  59     u=102  imp:n=1   $ clad
1627  102  -10.2144   -34  59       u=102  imp:n=1  vol=78.9937  $ fuel
1628  4  -1.785E-4   34 -35  59     u=102  imp:n=1   $ gap
1629  2  -6.74       35 -36  59     u=102  imp:n=1   $ clad
1630  102  -10.2144   -37  59       u=102  imp:n=1  vol=78.9937  $ fuel
1631  4  -1.785E-4   37 -38  59     u=102  imp:n=1   $ gap
1632  2  -6.74       38 -39  59     u=102  imp:n=1   $ clad
1633  102  -10.2144   -40  59       u=102  imp:n=1  vol=78.9937  $ fuel
1634  4  -1.785E-4   40 -41  59     u=102  imp:n=1   $ gap
1635  2  -6.74       41 -42  59     u=102  imp:n=1   $ clad
1636  102  -10.2144   -43  59       u=102  imp:n=1  vol=78.9937  $ fuel
1637  4  -1.785E-4   43 -44  59     u=102  imp:n=1   $ gap
1638  2  -6.74       44 -45  59     u=102  imp:n=1   $ clad
1639  102  -10.2144   -46  59       u=102  imp:n=1  vol=78.9937  $ fuel
1640  4  -1.785E-4   46 -47  59     u=102  imp:n=1   $ gap
1641  2  -6.74       47 -48  59     u=102  imp:n=1   $ clad
1642  102  -10.2144   -49  59       u=102  imp:n=1  vol=78.9937  $ fuel
1643  4  -1.785E-4   49 -50  59     u=102  imp:n=1   $ gap
1644  2  -6.74       50 -51  59     u=102  imp:n=1   $ clad
1645  102  -10.2144   -52  59       u=102  imp:n=1  vol=78.9937  $ fuel
1646  4  -1.785E-4   52 -53  59     u=102  imp:n=1   $ gap
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1647  2  -6.74       53 -54  59     u=102  imp:n=1   $ clad
1648  102  -10.2144   -55  59       u=102  imp:n=1  vol=78.9937  $ fuel
1649  4  -1.785E-4   55 -56  59     u=102  imp:n=1   $ gap
1650  2  -6.74       56 -57  59     u=102  imp:n=1   $ clad
1651  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=102  imp:n=1    $ D2O coolant
1652  3  -0.8143    -59 -60          u=102  imp:n=1    $ spacer
C      ************************************************************
1653   104  -10.2144   -1  59          u=104  imp:n=1  vol=78.9937  $ fuel
1654   4  -1.785E-4   1 -2  59       u=104  imp:n=1   $ gap
1655   2  -6.74       2 -3  59       u=104  imp:n=1   $ clad
1656   104  -10.2144   -4  59        u=104  imp:n=1  vol=78.9937  $ fuel
1657   4  -1.785E-4   4 -5  59       u=104  imp:n=1   $ gap
1658   2  -6.74       5 -6  59       u=104  imp:n=1   $ clad
1659   104  -10.2144   -7  59        u=104  imp:n=1  vol=78.9937  $ fuel
1660   4  -1.785E-4   7 -8  59       u=104  imp:n=1   $ gap
1661   2  -6.74       8 -9  59       u=104  imp:n=1   $ clad
1662  104  -10.2144   -10   59      u=104  imp:n=1  vol=78.9937  $ fuel
1663  4  -1.785E-4   10 -11  59     u=104  imp:n=1   $ gap
1664  2  -6.74       11 -12  59     u=104  imp:n=1   $ clad
1665  104  -10.2144   -13  59       u=104  imp:n=1  vol=78.9937  $ fuel
1666  4  -1.785E-4   13 -14  59     u=104  imp:n=1   $ gap
1667  2  -6.74       14 -15  59     u=104  imp:n=1   $ clad
1668  104  -10.2144   -16  59       u=104  imp:n=1  vol=78.9937  $ fuel
1669  4  -1.785E-4   16 -17  59     u=104  imp:n=1   $ gap
1670  2  -6.74       17 -18  59     u=104  imp:n=1   $ clad
1671  104  -10.2144   -19  59       u=104  imp:n=1  vol=78.9937  $ fuel
1672  4  -1.785E-4   19 -20  59     u=104  imp:n=1   $ gap
1673  2  -6.74       20 -21  59     u=104  imp:n=1   $ clad
1674  104  -10.2144   -22  59       u=104  imp:n=1  vol=78.9937  $ fuel
1675  4  -1.785E-4   22 -23  59     u=104  imp:n=1   $ gap
1676  2  -6.74       23 -24  59     u=104  imp:n=1   $ clad
1677  104  -10.2144   -25  59       u=104  imp:n=1  vol=78.9937  $ fuel
1678  4  -1.785E-4   25 -26  59     u=104  imp:n=1   $ gap
1679  2  -6.74       26 -27  59     u=104  imp:n=1   $ clad
1680  104  -10.2144   -28  59       u=104  imp:n=1  vol=78.9937  $ fuel
1681  4  -1.785E-4   28 -29  59     u=104  imp:n=1   $ gap
1682  2  -6.74       29 -30  59     u=104  imp:n=1   $ clad
1683  104  -10.2144   -31  59       u=104  imp:n=1  vol=78.9937  $ fuel
1684  4  -1.785E-4   31 -32  59     u=104  imp:n=1   $ gap
1685  2  -6.74       32 -33  59     u=104  imp:n=1   $ clad
1686  104  -10.2144   -34  59       u=104  imp:n=1  vol=78.9937  $ fuel
1687  4  -1.785E-4   34 -35  59     u=104  imp:n=1   $ gap
1688  2  -6.74       35 -36  59     u=104  imp:n=1   $ clad
1689  104  -10.2144   -37  59       u=104  imp:n=1  vol=78.9937  $ fuel
1690  4  -1.785E-4   37 -38  59     u=104  imp:n=1   $ gap
1691  2  -6.74       38 -39  59     u=104  imp:n=1   $ clad
1692  104  -10.2144   -40  59       u=104  imp:n=1  vol=78.9937  $ fuel
1693  4  -1.785E-4   40 -41  59     u=104  imp:n=1   $ gap
1694  2  -6.74       41 -42  59     u=104  imp:n=1   $ clad
1695  104  -10.2144   -43  59       u=104  imp:n=1  vol=78.9937  $ fuel
1696  4  -1.785E-4   43 -44  59     u=104  imp:n=1   $ gap
1697  2  -6.74       44 -45  59     u=104  imp:n=1   $ clad
1698  104  -10.2144   -46  59       u=104  imp:n=1  vol=78.9937  $ fuel
1699  4  -1.785E-4   46 -47  59     u=104  imp:n=1   $ gap
```

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1700  2  -6.74       47 -48  59     u=104  imp:n=1   $ clad
1701  104  -10.2144   -49  59       u=104  imp:n=1  vol=78.9937  $ fuel
1702  4  -1.785E-4   49 -50  59     u=104  imp:n=1   $ gap
1703  2  -6.74       50 -51  59     u=104  imp:n=1   $ clad
1704  104  -10.2144   -52  59       u=104  imp:n=1  vol=78.9937  $ fuel
1705  4  -1.785E-4   52 -53  59     u=104  imp:n=1   $ gap
1706  2  -6.74       53 -54  59     u=104  imp:n=1   $ clad
1707  104  -10.2144   -55  59       u=104  imp:n=1  vol=78.9937  $ fuel
1708  4  -1.785E-4   55 -56  59     u=104  imp:n=1   $ gap
1709  2  -6.74       56 -57  59     u=104  imp:n=1   $ clad
1710  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=104  imp:n=1    $ D2O coolant
1711  3  -0.8143    -59 -60          u=104  imp:n=1    $ spacer
C      ************************************************************
1712   111  -10.2144   -1  59          u=111  imp:n=1  vol=78.9937  $ fuel
1713   4  -1.785E-4   1 -2  59       u=111  imp:n=1   $ gap
1714   2  -6.74       2 -3  59       u=111  imp:n=1   $ clad
1715   111  -10.2144   -4  59       u=111  imp:n=1  vol=78.9937  $ fuel
1716   4  -1.785E-4   4 -5  59       u=111  imp:n=1   $ gap
1717   2  -6.74       5 -6  59       u=111  imp:n=1   $ clad
1718   111  -10.2144   -7  59       u=111  imp:n=1  vol=78.9937  $ fuel
1719   4  -1.785E-4   7 -8  59       u=111  imp:n=1   $ gap
1720   2  -6.74       8 -9  59       u=111  imp:n=1   $ clad
1721  111  -10.2144   -10   59      u=111  imp:n=1  vol=78.9937  $ fuel
1722  4  -1.785E-4   10 -11  59     u=111  imp:n=1   $ gap
1723  2  -6.74       11 -12  59     u=111  imp:n=1   $ clad
1724  111  -10.2144   -13  59       u=111  imp:n=1  vol=78.9937  $ fuel
1725  4  -1.785E-4   13 -14  59     u=111  imp:n=1   $ gap
1726  2  -6.74       14 -15  59     u=111  imp:n=1   $ clad
1727  111  -10.2144   -16  59       u=111  imp:n=1  vol=78.9937  $ fuel
1728  4  -1.785E-4   16 -17  59     u=111  imp:n=1   $ gap
1729  2  -6.74       17 -18  59     u=111  imp:n=1   $ clad
1730  111  -10.2144   -19  59       u=111  imp:n=1  vol=78.9937  $ fuel
1731  4  -1.785E-4   19 -20  59     u=111  imp:n=1   $ gap
1732  2  -6.74       20 -21  59     u=111  imp:n=1   $ clad
1733  111  -10.2144   -22  59       u=111  imp:n=1  vol=78.9937  $ fuel
1734  4  -1.785E-4   22 -23  59     u=111  imp:n=1   $ gap
1735  2  -6.74       23 -24  59     u=111  imp:n=1   $ clad
1736  111  -10.2144   -25  59       u=111  imp:n=1  vol=78.9937  $ fuel
1737  4  -1.785E-4   25 -26  59     u=111  imp:n=1   $ gap
1738  2  -6.74       26 -27  59     u=111  imp:n=1   $ clad
1739  111  -10.2144   -28  59       u=111  imp:n=1  vol=78.9937  $ fuel
1740  4  -1.785E-4   28 -29  59     u=111  imp:n=1   $ gap
1741  2  -6.74       29 -30  59     u=111  imp:n=1   $ clad
1742  111  -10.2144   -31  59       u=111  imp:n=1  vol=78.9937  $ fuel
1743  4  -1.785E-4   31 -32  59     u=111  imp:n=1   $ gap
1744  2  -6.74       32 -33  59     u=111  imp:n=1   $ clad
1745  111  -10.2144   -34  59       u=111  imp:n=1  vol=78.9937  $ fuel
1746  4  -1.785E-4   34 -35  59     u=111  imp:n=1   $ gap
1747  2  -6.74       35 -36  59     u=111  imp:n=1   $ clad
1748  111  -10.2144   -37  59       u=111  imp:n=1  vol=78.9937  $ fuel
1749  4  -1.785E-4   37 -38  59     u=111  imp:n=1   $ gap
1750  2  -6.74       38 -39  59     u=111  imp:n=1   $ clad
1751  111  -10.2144   -40  59       u=111  imp:n=1  vol=78.9937  $ fuel
1752  4  -1.785E-4   40 -41  59     u=111  imp:n=1   $ gap
```

```
1753  2  -6.74       41 -42  59     u=111  imp:n=1   $ clad
1754  111  -10.2144   -43  59       u=111  imp:n=1  vol=78.9937  $ fuel
1755  4  -1.785E-4   43 -44  59     u=111  imp:n=1   $ gap
1756  2  -6.74       44 -45  59     u=111  imp:n=1   $ clad
1757  111  -10.2144   -46  59       u=111  imp:n=1  vol=78.9937  $ fuel
1758  4  -1.785E-4   46 -47  59     u=111  imp:n=1   $ gap
1759  2  -6.74       47 -48  59     u=111  imp:n=1   $ clad
1760  111  -10.2144   -49  59       u=111  imp:n=1  vol=78.9937  $ fuel
1761  4  -1.785E-4   49 -50  59     u=111  imp:n=1   $ gap
1762  2  -6.74       50 -51  59     u=111  imp:n=1   $ clad
1763  111  -10.2144   -52  59       u=111  imp:n=1  vol=78.9937  $ fuel
1764  4  -1.785E-4   52 -53  59     u=111  imp:n=1   $ gap
1765  2  -6.74       53 -54  59     u=111  imp:n=1   $ clad
1766  111  -10.2144   -55  59       u=111  imp:n=1  vol=78.9937  $ fuel
1767  4  -1.785E-4   55 -56  59     u=111  imp:n=1   $ gap
1768  2  -6.74       56 -57  59     u=111  imp:n=1   $ clad
1769  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=111  imp:n=1    $ D2O coolant
1770  3  -0.8143    -59 -60          u=111  imp:n=1    $ spacer
C      ************************************************************
1771   112  -10.2144   -1  59         u=112  imp:n=1  vol=78.9937  $ fuel
1772   4  -1.785E-4   1 -2  59       u=112  imp:n=1   $ gap
1773   2  -6.74       2 -3  59       u=112  imp:n=1   $ clad
1774   112  -10.2144   -4  59        u=112  imp:n=1  vol=78.9937  $ fuel
1775   4  -1.785E-4   4 -5  59       u=112  imp:n=1   $ gap
1776   2  -6.74       5 -6  59       u=112  imp:n=1   $ clad
1777   112  -10.2144   -7  59        u=112  imp:n=1  vol=78.9937  $ fuel
1778   4  -1.785E-4   7 -8  59       u=112  imp:n=1   $ gap
1779   2  -6.74       8 -9  59       u=112  imp:n=1   $ clad
1780  112  -10.2144   -10   59      u=112  imp:n=1  vol=78.9937  $ fuel
1781  4  -1.785E-4   10 -11  59     u=112  imp:n=1   $ gap
1782  2  -6.74       11 -12  59     u=112  imp:n=1   $ clad
1783  112  -10.2144   -13  59       u=112  imp:n=1  vol=78.9937  $ fuel
1784  4  -1.785E-4   13 -14  59     u=112  imp:n=1   $ gap
1785  2  -6.74       14 -15  59     u=112  imp:n=1   $ clad
1786  112  -10.2144   -16  59       u=112  imp:n=1  vol=78.9937  $ fuel
1788  4  -1.785E-4   16 -17  59     u=112  imp:n=1   $ gap
1789  2  -6.74       17 -18  59     u=112  imp:n=1   $ clad
1790  112  -10.2144   -19  59       u=112  imp:n=1  vol=78.9937  $ fuel
1791  4  -1.785E-4   19 -20  59     u=112  imp:n=1   $ gap
1792  2  -6.74       20 -21  59     u=112  imp:n=1   $ clad
1793  112  -10.2144   -22  59       u=112  imp:n=1  vol=78.9937  $ fuel
1794  4  -1.785E-4   22 -23  59     u=112  imp:n=1   $ gap
1795  2  -6.74       23 -24  59     u=112  imp:n=1   $ clad
1796  112  -10.2144   -25  59       u=112  imp:n=1  vol=78.9937  $ fuel
1797  4  -1.785E-4   25 -26  59     u=112  imp:n=1   $ gap
1798  2  -6.74       26 -27  59     u=112  imp:n=1   $ clad
1799  112  -10.2144   -28  59       u=112  imp:n=1  vol=78.9937  $ fuel
1800  4  -1.785E-4   28 -29  59     u=112  imp:n=1   $ gap
1801  2  -6.74       29 -30  59     u=112  imp:n=1   $ clad
1802  112  -10.2144   -31  59       u=112  imp:n=1  vol=78.9937  $ fuel
1803  4  -1.785E-4   31 -32  59     u=112  imp:n=1   $ gap
1804  2  -6.74       32 -33  59     u=112  imp:n=1   $ clad
1805  112  -10.2144   -34  59       u=112  imp:n=1  vol=78.9937  $ fuel
1806  4  -1.785E-4   34 -35  59     u=112  imp:n=1   $ gap
```

```
1807  2  -6.74       35 -36  59     u=112  imp:n=1   $ clad
1808  112  -10.2144   -37  59       u=112  imp:n=1  vol=78.9937  $ fuel
1809  4  -1.785E-4   37 -38  59     u=112  imp:n=1   $ gap
1810  2  -6.74       38 -39  59     u=112  imp:n=1   $ clad
1811  112  -10.2144   -40  59       u=112  imp:n=1  vol=78.9937  $ fuel
1812  4  -1.785E-4   40 -41  59     u=112  imp:n=1   $ gap
1813  2  -6.74       41 -42  59     u=112  imp:n=1   $ clad
1814  112  -10.2144   -43  59       u=112  imp:n=1  vol=78.9937  $ fuel
1815  4  -1.785E-4   43 -44  59     u=112  imp:n=1   $ gap
1816  2  -6.74       44 -45  59     u=112  imp:n=1   $ clad
1817  112  -10.2144   -46  59       u=112  imp:n=1  vol=78.9937  $ fuel
1818  4  -1.785E-4   46 -47  59     u=112  imp:n=1   $ gap
1819  2  -6.74       47 -48  59     u=112  imp:n=1   $ clad
1820  112  -10.2144   -49  59       u=112  imp:n=1  vol=78.9937  $ fuel
1821  4  -1.785E-4   49 -50  59     u=112  imp:n=1   $ gap
1822  2  -6.74       50 -51  59     u=112  imp:n=1   $ clad
1823  112  -10.2144   -52  59       u=112  imp:n=1  vol=78.9937  $ fuel
1824  4  -1.785E-4   52 -53  59     u=112  imp:n=1   $ gap
1825  2  -6.74       53 -54  59     u=112  imp:n=1   $ clad
1826  112  -10.2144   -55  59       u=112  imp:n=1  vol=78.9937  $ fuel
1827  4  -1.785E-4   55 -56  59     u=112  imp:n=1   $ gap
1828  2  -6.74       56 -57  59     u=112  imp:n=1   $ clad
1829  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=112  imp:n=1    $ D2O coolant
1830  3  -0.8143    -59 -60          u=112  imp:n=1    $ spacer
C      ********************************************************************
1831   114  -10.2144   -1  59          u=114  imp:n=1  vol=78.9937  $ fuel
1832   4  -1.785E-4   1 -2  59       u=114  imp:n=1   $ gap
1833   2  -6.74       2 -3  59       u=114  imp:n=1   $ clad
1834   114  -10.2144   -4  59       u=114  imp:n=1  vol=78.9937  $ fuel
1835   4  -1.785E-4   4 -5  59       u=114  imp:n=1   $ gap
1836   2  -6.74       5 -6  59       u=114  imp:n=1   $ clad
1837   114  -10.2144   -7  59       u=114  imp:n=1  vol=78.9937  $ fuel
1838   4  -1.785E-4   7 -8  59       u=114  imp:n=1   $ gap
1839   2  -6.74       8 -9  59       u=114  imp:n=1   $ clad
1840  114  -10.2144   -10   59      u=114  imp:n=1  vol=78.9937  $ fuel
1841  4  -1.785E-4   10 -11  59     u=114  imp:n=1   $ gap
1842  2  -6.74       11 -12  59     u=114  imp:n=1   $ clad
1843  114  -10.2144   -13  59       u=114  imp:n=1  vol=78.9937  $ fuel
1844  4  -1.785E-4   13 -14  59     u=114  imp:n=1   $ gap
1845  2  -6.74       14 -15  59     u=114  imp:n=1   $ clad
1846  114  -10.2144   -16  59       u=114  imp:n=1  vol=78.9937  $ fuel
1847  4  -1.785E-4   16 -17  59     u=114  imp:n=1   $ gap
1848  2  -6.74       17 -18  59     u=114  imp:n=1   $ clad
1849  114  -10.2144   -19  59       u=114  imp:n=1  vol=78.9937  $ fuel
1850  4  -1.785E-4   19 -20  59     u=114  imp:n=1   $ gap
1851  2  -6.74       20 -21  59     u=114  imp:n=1   $ clad
1852  114  -10.2144   -22  59       u=114  imp:n=1  vol=78.9937  $ fuel
1853  4  -1.785E-4   22 -23  59     u=114  imp:n=1   $ gap
1854  2  -6.74       23 -24  59     u=114  imp:n=1   $ clad
1855  114  -10.2144   -25  59       u=114  imp:n=1  vol=78.9937  $ fuel
1856  4  -1.785E-4   25 -26  59     u=114  imp:n=1   $ gap
1857  2  -6.74       26 -27  59     u=114  imp:n=1   $ clad
1858  114  -10.2144   -28  59       u=114  imp:n=1  vol=78.9937  $ fuel
1859  4  -1.785E-4   28 -29  59     u=114  imp:n=1   $ gap
```

```
1860  2  -6.74       29 -30  59     u=114  imp:n=1   $ clad
1861  114  -10.2144   -31  59       u=114  imp:n=1  vol=78.9937  $ fuel
1862  4  -1.785E-4   31 -32  59     u=114  imp:n=1   $ gap
1863  2  -6.74       32 -33  59     u=114  imp:n=1   $ clad
1864  114  -10.2144   -34  59       u=114  imp:n=1  vol=78.9937  $ fuel
1865  4  -1.785E-4   34 -35  59     u=114  imp:n=1   $ gap
1866  2  -6.74       35 -36  59     u=114  imp:n=1   $ clad
1867  114  -10.2144   -37  59       u=114  imp:n=1  vol=78.9937  $ fuel
1868  4  -1.785E-4   37 -38  59     u=114  imp:n=1   $ gap
1869  2  -6.74       38 -39  59     u=114  imp:n=1   $ clad
1870  114  -10.2144   -40  59       u=114  imp:n=1  vol=78.9937  $ fuel
1871  4  -1.785E-4   40 -41  59     u=114  imp:n=1   $ gap
1872  2  -6.74       41 -42  59     u=114  imp:n=1   $ clad
1873  114  -10.2144   -43  59       u=114  imp:n=1  vol=78.9937  $ fuel
1874  4  -1.785E-4   43 -44  59     u=114  imp:n=1   $ gap
1875  2  -6.74       44 -45  59     u=114  imp:n=1   $ clad
1876  114  -10.2144   -46  59       u=114  imp:n=1  vol=78.9937  $ fuel
1877  4  -1.785E-4   46 -47  59     u=114  imp:n=1   $ gap
1878  2  -6.74       47 -48  59     u=114  imp:n=1   $ clad
1879  114  -10.2144   -49  59       u=114  imp:n=1  vol=78.9937  $ fuel
1880  4  -1.785E-4   49 -50  59     u=114  imp:n=1   $ gap
1881  2  -6.74       50 -51  59     u=114  imp:n=1   $ clad
1882  114  -10.2144   -52  59       u=114  imp:n=1  vol=78.9937  $ fuel
1883  4  -1.785E-4   52 -53  59     u=114  imp:n=1   $ gap
1884  2  -6.74       53 -54  59     u=114  imp:n=1   $ clad
1885  114  -10.2144   -55  59       u=114  imp:n=1  vol=78.9937  $ fuel
1886  4  -1.785E-4   55 -56  59     u=114  imp:n=1   $ gap
1887  2  -6.74       56 -57  59     u=114  imp:n=1   $ clad
1888  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=114  imp:n=1    $ D2O coolant
1889  3  -0.8143    -59 -60          u=114  imp:n=1    $ spacer
C      ********************************************************************
1890   121  -10.2144   -1  59         u=121  imp:n=1  vol=78.9937  $ fuel
1891   4  -1.785E-4   1 -2  59       u=121  imp:n=1   $ gap
1892   2  -6.74       2 -3  59       u=121  imp:n=1   $ clad
1893   121  -10.2144   -4  59       u=121  imp:n=1  vol=78.9937  $ fuel
1894   4  -1.785E-4   4 -5  59       u=121  imp:n=1   $ gap
1895   2  -6.74       5 -6  59       u=121  imp:n=1   $ clad
1896   121  -10.2144   -7  59       u=121  imp:n=1  vol=78.9937  $ fuel
1897   4  -1.785E-4   7 -8  59       u=121  imp:n=1   $ gap
1898   2  -6.74       8 -9  59       u=121  imp:n=1   $ clad
1899  121  -10.2144   -10   59      u=121  imp:n=1  vol=78.9937  $ fuel
1900  4  -1.785E-4   10 -11  59     u=121  imp:n=1   $ gap
1901  2  -6.74       11 -12  59     u=121  imp:n=1   $ clad
1902  121  -10.2144   -13  59       u=121  imp:n=1  vol=78.9937  $ fuel
1903  4  -1.785E-4   13 -14  59     u=121  imp:n=1   $ gap
1904  2  -6.74       14 -15  59     u=121  imp:n=1   $ clad
1905  121  -10.2144   -16  59       u=121  imp:n=1  vol=78.9937  $ fuel
1906  4  -1.785E-4   16 -17  59     u=121  imp:n=1   $ gap
1907  2  -6.74       17 -18  59     u=121  imp:n=1   $ clad
1908  121  -10.2144   -19  59       u=121  imp:n=1  vol=78.9937  $ fuel
1909  4  -1.785E-4   19 -20  59     u=121  imp:n=1   $ gap
1910  2  -6.74       20 -21  59     u=121  imp:n=1   $ clad
1911  121  -10.2144   -22  59       u=121  imp:n=1  vol=78.9937  $ fuel
1912  4  -1.785E-4   22 -23  59     u=121  imp:n=1   $ gap
```

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1913  2  -6.74       23 -24  59     u=121  imp:n=1   $ clad
1914  121  -10.2144   -25  59       u=121  imp:n=1  vol=78.9937  $ fuel
1915  4  -1.785E-4   25 -26  59     u=121  imp:n=1   $ gap
1916  2  -6.74       26 -27  59     u=121  imp:n=1   $ clad
1917  121  -10.2144   -28  59       u=121  imp:n=1  vol=78.9937  $ fuel
1918  4  -1.785E-4   28 -29  59     u=121  imp:n=1   $ gap
1919  2  -6.74       29 -30  59     u=121  imp:n=1   $ clad
1920  121  -10.2144   -31  59       u=121  imp:n=1  vol=78.9937  $ fuel
1921  4  -1.785E-4   31 -32  59     u=121  imp:n=1   $ gap
1922  2  -6.74       32 -33  59     u=121  imp:n=1   $ clad
1923  121  -10.2144   -34  59       u=121  imp:n=1  vol=78.9937  $ fuel
1924  4  -1.785E-4   34 -35  59     u=121  imp:n=1   $ gap
1925  2  -6.74       35 -36  59     u=121  imp:n=1   $ clad
1926  121  -10.2144   -37  59       u=121  imp:n=1  vol=78.9937  $ fuel
1927  4  -1.785E-4   37 -38  59     u=121  imp:n=1   $ gap
1928  2  -6.74       38 -39  59     u=121  imp:n=1   $ clad
1929  121  -10.2144   -40  59       u=121  imp:n=1  vol=78.9937  $ fuel
1930  4  -1.785E-4   40 -41  59     u=121  imp:n=1   $ gap
1931  2  -6.74       41 -42  59     u=121  imp:n=1   $ clad
1932  121  -10.2144   -43  59       u=121  imp:n=1  vol=78.9937  $ fuel
1933  4  -1.785E-4   43 -44  59     u=121  imp:n=1   $ gap
1934  2  -6.74       44 -45  59     u=121  imp:n=1   $ clad
1935  121  -10.2144   -46  59       u=121  imp:n=1  vol=78.9937  $ fuel
1936  4  -1.785E-4   46 -47  59     u=121  imp:n=1   $ gap
1937  2  -6.74       47 -48  59     u=121  imp:n=1   $ clad
1938  121  -10.2144   -49  59       u=121  imp:n=1  vol=78.9937  $ fuel
1939  4  -1.785E-4   49 -50  59     u=121  imp:n=1   $ gap
1940  2  -6.74       50 -51  59     u=121  imp:n=1   $ clad
1941  121  -10.2144   -52  59       u=121  imp:n=1  vol=78.9937  $ fuel
1942  4  -1.785E-4   52 -53  59     u=121  imp:n=1   $ gap
1943  2  -6.74       53 -54  59     u=121  imp:n=1   $ clad
1944  121  -10.2144   -55  59       u=121  imp:n=1  vol=78.9937  $ fuel
1945  4  -1.785E-4   55 -56  59     u=121  imp:n=1   $ gap
1946  2  -6.74       56 -57  59     u=121  imp:n=1   $ clad
1947  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=121  imp:n=1    $ D2O coolant
1948  3  -0.8143    -59 -60          u=121  imp:n=1    $ spacer
C      ************************************************************
1949   122  -10.2144   -1  59         u=122  imp:n=1  vol=78.9937  $ fuel
1950   4  -1.785E-4   1 -2  59       u=122  imp:n=1   $ gap
1951   2  -6.74       2 -3  59       u=122  imp:n=1   $ clad
1952   122  -10.2144   -4  59       u=122  imp:n=1  vol=78.9937  $ fuel
1953   4  -1.785E-4   4 -5  59       u=122  imp:n=1   $ gap
1954   2  -6.74       5 -6  59       u=122  imp:n=1   $ clad
1955   122  -10.2144   -7  59       u=122  imp:n=1  vol=78.9937  $ fuel
1956   4  -1.785E-4   7 -8  59       u=122  imp:n=1   $ gap
1957   2  -6.74       8 -9  59       u=122  imp:n=1   $ clad
1958  122  -10.2144   -10   59      u=122  imp:n=1  vol=78.9937  $ fuel
1959  4  -1.785E-4   10 -11  59     u=122  imp:n=1   $ gap
1960  2  -6.74       11 -12  59     u=122  imp:n=1   $ clad
1961  122  -10.2144   -13  59       u=122  imp:n=1  vol=78.9937  $ fuel
1962  4  -1.785E-4   13 -14  59     u=122  imp:n=1   $ gap
1963  2  -6.74       14 -15  59     u=122  imp:n=1   $ clad
1964  122  -10.2144   -16  59       u=122  imp:n=1  vol=78.9937  $ fuel
1965  4  -1.785E-4   16 -17  59     u=122  imp:n=1   $ gap
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1966  2  -6.74       17 -18  59     u=122  imp:n=1   $ clad
1967  122  -10.2144   -19  59       u=122  imp:n=1  vol=78.9937  $ fuel
1968  4  -1.785E-4   19 -20  59     u=122  imp:n=1   $ gap
1969  2  -6.74       20 -21  59     u=122  imp:n=1   $ clad
1970  122  -10.2144   -22  59       u=122  imp:n=1  vol=78.9937  $ fuel
1971  4  -1.785E-4   22 -23  59     u=122  imp:n=1   $ gap
1972  2  -6.74       23 -24  59     u=122  imp:n=1   $ clad
1973  122  -10.2144   -25  59       u=122  imp:n=1  vol=78.9937  $ fuel
1974  4  -1.785E-4   25 -26  59     u=122  imp:n=1   $ gap
1975  2  -6.74       26 -27  59     u=122  imp:n=1   $ clad
1976  122  -10.2144   -28  59       u=122  imp:n=1  vol=78.9937  $ fuel
1977  4  -1.785E-4   28 -29  59     u=122  imp:n=1   $ gap
1978  2  -6.74       29 -30  59     u=122  imp:n=1   $ clad
1979  122  -10.2144   -31  59       u=122  imp:n=1  vol=78.9937  $ fuel
1980  4  -1.785E-4   31 -32  59     u=122  imp:n=1   $ gap
1981  2  -6.74       32 -33  59     u=122  imp:n=1   $ clad
1982  122  -10.2144   -34  59       u=122  imp:n=1  vol=78.9937  $ fuel
1983  4  -1.785E-4   34 -35  59     u=122  imp:n=1   $ gap
1984  2  -6.74       35 -36  59     u=122  imp:n=1   $ clad
1985  122  -10.2144   -37  59       u=122  imp:n=1  vol=78.9937  $ fuel
1986  4  -1.785E-4   37 -38  59     u=122  imp:n=1   $ gap
1987  2  -6.74       38 -39  59     u=122  imp:n=1   $ clad
1988  122  -10.2144   -40  59       u=122  imp:n=1  vol=78.9937  $ fuel
1989  4  -1.785E-4   40 -41  59     u=122  imp:n=1   $ gap
1990  2  -6.74       41 -42  59     u=122  imp:n=1   $ clad
1991  122  -10.2144   -43  59       u=122  imp:n=1  vol=78.9937  $ fuel
1992  4  -1.785E-4   43 -44  59     u=122  imp:n=1   $ gap
1993  2  -6.74       44 -45  59     u=122  imp:n=1   $ clad
1994  122  -10.2144   -46  59       u=122  imp:n=1  vol=78.9937  $ fuel
1995  4  -1.785E-4   46 -47  59     u=122  imp:n=1   $ gap
1996  2  -6.74       47 -48  59     u=122  imp:n=1   $ clad
1997  122  -10.2144   -49  59       u=122  imp:n=1  vol=78.9937  $ fuel
1998  4  -1.785E-4   49 -50  59     u=122  imp:n=1   $ gap
1999  2  -6.74       50 -51  59     u=122  imp:n=1   $ clad
2000  122  -10.2144   -52  59       u=122  imp:n=1  vol=78.9937  $ fuel
2001  4  -1.785E-4   52 -53  59     u=122  imp:n=1   $ gap
2002  2  -6.74       53 -54  59     u=122  imp:n=1   $ clad
2003  122  -10.2144   -55  59       u=122  imp:n=1  vol=78.9937  $ fuel
2004  4  -1.785E-4   55 -56  59     u=122  imp:n=1   $ gap
2005  2  -6.74       56 -57  59     u=122  imp:n=1   $ clad
2006  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=122  imp:n=1    $ D2O coolant
2007  3  -0.8143    -59 -60          u=122  imp:n=1    $ spacer
C      ********************************************************************
2008   124  -10.2144   -1  59          u=124  imp:n=1  vol=78.9937  $ fuel
2009   4  -1.785E-4   1 -2  59       u=124  imp:n=1   $ gap
2010   2  -6.74       2 -3  59       u=124  imp:n=1   $ clad
2011   124  -10.2144   -4  59       u=124  imp:n=1  vol=78.9937  $ fuel
2012   4  -1.785E-4   4 -5  59       u=124  imp:n=1   $ gap
2013   2  -6.74       5 -6  59       u=124  imp:n=1   $ clad
2014   124  -10.2144   -7  59       u=124  imp:n=1  vol=78.9937  $ fuel
2015   4  -1.785E-4   7 -8  59       u=124  imp:n=1   $ gap
2016   2  -6.74       8 -9  59       u=124  imp:n=1   $ clad
2017  124  -10.2144   -10   59      u=124  imp:n=1  vol=78.9937  $ fuel
2018  4  -1.785E-4   10 -11  59     u=124  imp:n=1   $ gap
```

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2019  2  -6.74       11 -12  59     u=124  imp:n=1   $ clad
2020  124  -10.2144   -13  59       u=124  imp:n=1  vol=78.9937  $ fuel
2021  4  -1.785E-4   13 -14  59     u=124  imp:n=1   $ gap
2022  2  -6.74       14 -15  59     u=124  imp:n=1   $ clad
2023  124  -10.2144   -16  59       u=124  imp:n=1  vol=78.9937  $ fuel
2024  4  -1.785E-4   16 -17  59     u=124  imp:n=1   $ gap
2025  2  -6.74       17 -18  59     u=124  imp:n=1   $ clad
2026  124  -10.2144   -19  59       u=124  imp:n=1  vol=78.9937  $ fuel
2027  4  -1.785E-4   19 -20  59     u=124  imp:n=1   $ gap
2028  2  -6.74       20 -21  59     u=124  imp:n=1   $ clad
2029  124  -10.2144   -22  59       u=124  imp:n=1  vol=78.9937  $ fuel
2030  4  -1.785E-4   22 -23  59     u=124  imp:n=1   $ gap
2031  2  -6.74       23 -24  59     u=124  imp:n=1   $ clad
2032  124  -10.2144   -25  59       u=124  imp:n=1  vol=78.9937  $ fuel
2033  4  -1.785E-4   25 -26  59     u=124  imp:n=1   $ gap
2034  2  -6.74       26 -27  59     u=124  imp:n=1   $ clad
2035  124  -10.2144   -28  59       u=124  imp:n=1  vol=78.9937  $ fuel
2036  4  -1.785E-4   28 -29  59     u=124  imp:n=1   $ gap
2037  2  -6.74       29 -30  59     u=124  imp:n=1   $ clad
2038  124  -10.2144   -31  59       u=124  imp:n=1  vol=78.9937  $ fuel
2039  4  -1.785E-4   31 -32  59     u=124  imp:n=1   $ gap
2040  2  -6.74       32 -33  59     u=124  imp:n=1   $ clad
2041  124  -10.2144   -34  59       u=124  imp:n=1  vol=78.9937  $ fuel
2042  4  -1.785E-4   34 -35  59     u=124  imp:n=1   $ gap
2043  2  -6.74       35 -36  59     u=124  imp:n=1   $ clad
2044  124  -10.2144   -37  59       u=124  imp:n=1  vol=78.9937  $ fuel
2045  4  -1.785E-4   37 -38  59     u=124  imp:n=1   $ gap
2046  2  -6.74       38 -39  59     u=124  imp:n=1   $ clad
2047  124  -10.2144   -40  59       u=124  imp:n=1  vol=78.9937  $ fuel
2048  4  -1.785E-4   40 -41  59     u=124  imp:n=1   $ gap
2049  2  -6.74       41 -42  59     u=124  imp:n=1   $ clad
2050  124  -10.2144   -43  59       u=124  imp:n=1  vol=78.9937  $ fuel
2051  4  -1.785E-4   43 -44  59     u=124  imp:n=1   $ gap
2052  2  -6.74       44 -45  59     u=124  imp:n=1   $ clad
2053  124  -10.2144   -46  59       u=124  imp:n=1  vol=78.9937  $ fuel
2054  4  -1.785E-4   46 -47  59     u=124  imp:n=1   $ gap
2055  2  -6.74       47 -48  59     u=124  imp:n=1   $ clad
2056  124  -10.2144   -49  59       u=124  imp:n=1  vol=78.9937  $ fuel
2057  4  -1.785E-4   49 -50  59     u=124  imp:n=1   $ gap
2058  2  -6.74       50 -51  59     u=124  imp:n=1   $ clad
2059  124  -10.2144   -52  59       u=124  imp:n=1  vol=78.9937  $ fuel
2060  4  -1.785E-4   52 -53  59     u=124  imp:n=1   $ gap
2061  2  -6.74       53 -54  59     u=124  imp:n=1   $ clad
2062  124  -10.2144   -55  59       u=124  imp:n=1  vol=78.9937  $ fuel
2063  4  -1.785E-4   55 -56  59     u=124  imp:n=1   $ gap
2064  2  -6.74       56 -57  59     u=124  imp:n=1   $ clad
2065  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=124  imp:n=1    $ D2O coolant
2066  3  -0.8143    -59 -60          u=124  imp:n=1    $ spacer
C      ************************************************************
2067   131  -10.2144   -1  59        u=131  imp:n=1  vol=78.9937  $ fuel
2068   4  -1.785E-4   1 -2  59       u=131  imp:n=1   $ gap
2069   2  -6.74       2 -3  59       u=131  imp:n=1   $ clad
2070   131  -10.2144   -4  59        u=131  imp:n=1  vol=78.9937  $ fuel
2071   4  -1.785E-4   4 -5  59       u=131  imp:n=1   $ gap
```

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2072   2  -6.74       5 -6  59       u=131  imp:n=1   $ clad
2073   131  -10.2144   -7  59        u=131  imp:n=1  vol=78.9937  $ fuel
2074   4  -1.785E-4   7 -8  59       u=131  imp:n=1   $ gap
2075   2  -6.74       8 -9  59       u=131  imp:n=1   $ clad
2076  131  -10.2144   -10   59      u=131  imp:n=1  vol=78.9937  $ fuel
2077  4  -1.785E-4   10 -11  59     u=131  imp:n=1   $ gap
2078  2  -6.74       11 -12  59     u=131  imp:n=1   $ clad
2079  131  -10.2144   -13  59       u=131  imp:n=1  vol=78.9937  $ fuel
2080  4  -1.785E-4   13 -14  59     u=131  imp:n=1   $ gap
2081  2  -6.74       14 -15  59     u=131  imp:n=1   $ clad
2082  131  -10.2144   -16  59       u=131  imp:n=1  vol=78.9937  $ fuel
2083  4  -1.785E-4   16 -17  59     u=131  imp:n=1   $ gap
2084  2  -6.74       17 -18  59     u=131  imp:n=1   $ clad
2085  131  -10.2144   -19  59       u=131  imp:n=1  vol=78.9937  $ fuel
2086  4  -1.785E-4   19 -20  59     u=131  imp:n=1   $ gap
2087  2  -6.74       20 -21  59     u=131  imp:n=1   $ clad
2088  131  -10.2144   -22  59       u=131  imp:n=1  vol=78.9937  $ fuel
2089  4  -1.785E-4   22 -23  59     u=131  imp:n=1   $ gap
2090  2  -6.74       23 -24  59     u=131  imp:n=1   $ clad
2091  131  -10.2144   -25  59       u=131  imp:n=1  vol=78.9937  $ fuel
2092  4  -1.785E-4   25 -26  59     u=131  imp:n=1   $ gap
2093  2  -6.74       26 -27  59     u=131  imp:n=1   $ clad
2094  131  -10.2144   -28  59       u=131  imp:n=1  vol=78.9937  $ fuel
2095  4  -1.785E-4   28 -29  59     u=131  imp:n=1   $ gap
2096  2  -6.74       29 -30  59     u=131  imp:n=1   $ clad
2097  131  -10.2144   -31  59       u=131  imp:n=1  vol=78.9937  $ fuel
2098  4  -1.785E-4   31 -32  59     u=131  imp:n=1   $ gap
2099  2  -6.74       32 -33  59     u=131  imp:n=1   $ clad
2100  131  -10.2144   -34  59       u=131  imp:n=1  vol=78.9937  $ fuel
2101  4  -1.785E-4   34 -35  59     u=131  imp:n=1   $ gap
2102  2  -6.74       35 -36  59     u=131  imp:n=1   $ clad
2103  131  -10.2144   -37  59       u=131  imp:n=1  vol=78.9937  $ fuel
2104  4  -1.785E-4   37 -38  59     u=131  imp:n=1   $ gap
2105  2  -6.74       38 -39  59     u=131  imp:n=1   $ clad
2106  131  -10.2144   -40  59       u=131  imp:n=1  vol=78.9937  $ fuel
2107  4  -1.785E-4   40 -41  59     u=131  imp:n=1   $ gap
2108  2  -6.74       41 -42  59     u=131  imp:n=1   $ clad
2109  131  -10.2144   -43  59       u=131  imp:n=1  vol=78.9937  $ fuel
2110  4  -1.785E-4   43 -44  59     u=131  imp:n=1   $ gap
2111  2  -6.74       44 -45  59     u=131  imp:n=1   $ clad
2112  131  -10.2144   -46  59       u=131  imp:n=1  vol=78.9937  $ fuel
2113  4  -1.785E-4   46 -47  59     u=131  imp:n=1   $ gap
2114  2  -6.74       47 -48  59     u=131  imp:n=1   $ clad
2115  131  -10.2144   -49  59       u=131  imp:n=1  vol=78.9937  $ fuel
2116  4  -1.785E-4   49 -50  59     u=131  imp:n=1   $ gap
2117  2  -6.74       50 -51  59     u=131  imp:n=1   $ clad
2118  131  -10.2144   -52  59       u=131  imp:n=1  vol=78.9937  $ fuel
2119  4  -1.785E-4   52 -53  59     u=131  imp:n=1   $ gap
2120  2  -6.74       53 -54  59     u=131  imp:n=1   $ clad
2121  131  -10.2144   -55  59       u=131  imp:n=1  vol=78.9937  $ fuel
2122  4  -1.785E-4   55 -56  59     u=131  imp:n=1   $ gap
2123  2  -6.74       56 -57  59     u=131  imp:n=1   $ clad
2124  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=131  imp:n=1    $ D2O coolant
2125  3  -0.8143    -59 -60          u=131  imp:n=1    $ spacer
```

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C      ********************************************************************
2126   132  -10.2144   -1  59        u=132  imp:n=1  vol=78.9937  $ fuel
2127   4  -1.785E-4   1 -2  59       u=132  imp:n=1   $ gap
2128   2  -6.74       2 -3  59       u=132  imp:n=1   $ clad
2129   132  -10.2144   -4  59        u=132  imp:n=1  vol=78.9937  $ fuel
2130   4  -1.785E-4   4 -5  59       u=132  imp:n=1   $ gap
2131   2  -6.74       5 -6  59       u=132  imp:n=1   $ clad
2132   132  -10.2144   -7  59        u=132  imp:n=1  vol=78.9937  $ fuel
2133   4  -1.785E-4   7 -8  59       u=132  imp:n=1   $ gap
2134   2  -6.74       8 -9  59       u=132  imp:n=1   $ clad
2135  132  -10.2144   -10   59      u=132  imp:n=1  vol=78.9937  $ fuel
2136  4  -1.785E-4   10 -11  59     u=132  imp:n=1   $ gap
2137  2  -6.74       11 -12  59     u=132  imp:n=1   $ clad
2138  132  -10.2144   -13  59       u=132  imp:n=1  vol=78.9937  $ fuel
2139  4  -1.785E-4   13 -14  59     u=132  imp:n=1   $ gap
2140  2  -6.74       14 -15  59     u=132  imp:n=1   $ clad
2141  132  -10.2144   -16  59       u=132  imp:n=1  vol=78.9937  $ fuel
2142  4  -1.785E-4   16 -17  59     u=132  imp:n=1   $ gap
2143  2  -6.74       17 -18  59     u=132  imp:n=1   $ clad
2144  132  -10.2144   -19  59       u=132  imp:n=1  vol=78.9937  $ fuel
2145  4  -1.785E-4   19 -20  59     u=132  imp:n=1   $ gap
2146  2  -6.74       20 -21  59     u=132  imp:n=1   $ clad
2147  132  -10.2144   -22  59       u=132  imp:n=1  vol=78.9937  $ fuel
2148  4  -1.785E-4   22 -23  59     u=132  imp:n=1   $ gap
2149  2  -6.74       23 -24  59     u=132  imp:n=1   $ clad
2150  132  -10.2144   -25  59       u=132  imp:n=1  vol=78.9937  $ fuel
2151  4  -1.785E-4   25 -26  59     u=132  imp:n=1   $ gap
2152  2  -6.74       26 -27  59     u=132  imp:n=1   $ clad
2153  132  -10.2144   -28  59       u=132  imp:n=1  vol=78.9937  $ fuel
2154  4  -1.785E-4   28 -29  59     u=132  imp:n=1   $ gap
2155  2  -6.74       29 -30  59     u=132  imp:n=1   $ clad
2156  132  -10.2144   -31  59       u=132  imp:n=1  vol=78.9937  $ fuel
2157  4  -1.785E-4   31 -32  59     u=132  imp:n=1   $ gap
2158  2  -6.74       32 -33  59     u=132  imp:n=1   $ clad
2159  132  -10.2144   -34  59       u=132  imp:n=1  vol=78.9937  $ fuel
2160  4  -1.785E-4   34 -35  59     u=132  imp:n=1   $ gap
2161  2  -6.74       35 -36  59     u=132  imp:n=1   $ clad
2162  132  -10.2144   -37  59       u=132  imp:n=1  vol=78.9937  $ fuel
2163  4  -1.785E-4   37 -38  59     u=132  imp:n=1   $ gap
2164  2  -6.74       38 -39  59     u=132  imp:n=1   $ clad
2165  132  -10.2144   -40  59       u=132  imp:n=1  vol=78.9937  $ fuel
2166  4  -1.785E-4   40 -41  59     u=132  imp:n=1   $ gap
2167  2  -6.74       41 -42  59     u=132  imp:n=1   $ clad
2168  132  -10.2144   -43  59       u=132  imp:n=1  vol=78.9937  $ fuel
2169  4  -1.785E-4   43 -44  59     u=132  imp:n=1   $ gap
2170  2  -6.74       44 -45  59     u=132  imp:n=1   $ clad
2171  132  -10.2144   -46  59       u=132  imp:n=1  vol=78.9937  $ fuel
2172  4  -1.785E-4   46 -47  59     u=132  imp:n=1   $ gap
2173  2  -6.74       47 -48  59     u=132  imp:n=1   $ clad
2174  132  -10.2144   -49  59       u=132  imp:n=1  vol=78.9937  $ fuel
2175  4  -1.785E-4   49 -50  59     u=132  imp:n=1   $ gap
2176  2  -6.74       50 -51  59     u=132  imp:n=1   $ clad
2177  132  -10.2144   -52  59       u=132  imp:n=1  vol=78.9937  $ fuel
2178  4  -1.785E-4   52 -53  59     u=132  imp:n=1   $ gap
2179  2  -6.74       53 -54  59     u=132  imp:n=1   $ clad
```

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2180  132  -10.2144   -55  59       u=132  imp:n=1  vol=78.9937  $ fuel
2181  4  -1.785E-4   55 -56  59     u=132  imp:n=1   $ gap
2182  2  -6.74       56 -57  59     u=132  imp:n=1   $ clad
2183  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=132  imp:n=1    $ D2O coolant
2184  3  -0.8143    -59 -60          u=132  imp:n=1    $ spacer
C      ************************************************************
2185   134  -10.2144   -1  59        u=134  imp:n=1  vol=78.9937  $ fuel
2186   4  -1.785E-4   1 -2  59       u=134  imp:n=1   $ gap
2187   2  -6.74       2 -3  59       u=134  imp:n=1   $ clad
2188   134  -10.2144   -4  59        u=134  imp:n=1  vol=78.9937  $ fuel
2189   4  -1.785E-4   4 -5  59       u=134  imp:n=1   $ gap
2190   2  -6.74       5 -6  59       u=134  imp:n=1   $ clad
2191   134  -10.2144   -7  59        u=134  imp:n=1  vol=78.9937  $ fuel
2192   4  -1.785E-4   7 -8  59       u=134  imp:n=1   $ gap
2193   2  -6.74       8 -9  59       u=134  imp:n=1   $ clad
2194  134  -10.2144   -10   59      u=134  imp:n=1  vol=78.9937  $ fuel
2195  4  -1.785E-4   10 -11  59     u=134  imp:n=1   $ gap
2196  2  -6.74       11 -12  59     u=134  imp:n=1   $ clad
2197  134  -10.2144   -13  59       u=134  imp:n=1  vol=78.9937  $ fuel
2198  4  -1.785E-4   13 -14  59     u=134  imp:n=1   $ gap
2199  2  -6.74       14 -15  59     u=134  imp:n=1   $ clad
2200  134  -10.2144   -16  59       u=134  imp:n=1  vol=78.9937  $ fuel
2201  4  -1.785E-4   16 -17  59     u=134  imp:n=1   $ gap
2202  2  -6.74       17 -18  59     u=134  imp:n=1   $ clad
2203  134  -10.2144   -19  59       u=134  imp:n=1  vol=78.9937  $ fuel
2204  4  -1.785E-4   19 -20  59     u=134  imp:n=1   $ gap
2205  2  -6.74       20 -21  59     u=134  imp:n=1   $ clad
2206  134  -10.2144   -22  59       u=134  imp:n=1  vol=78.9937  $ fuel
2207  4  -1.785E-4   22 -23  59     u=134  imp:n=1   $ gap
2208  2  -6.74       23 -24  59     u=134  imp:n=1   $ clad
2209  134  -10.2144   -25  59       u=134  imp:n=1  vol=78.9937  $ fuel
2210  4  -1.785E-4   25 -26  59     u=134  imp:n=1   $ gap
2211  2  -6.74       26 -27  59     u=134  imp:n=1   $ clad
2212  134  -10.2144   -28  59       u=134  imp:n=1  vol=78.9937  $ fuel
2213  4  -1.785E-4   28 -29  59     u=134  imp:n=1   $ gap
2214  2  -6.74       29 -30  59     u=134  imp:n=1   $ clad
2215  134  -10.2144   -31  59       u=134  imp:n=1  vol=78.9937  $ fuel
2216  4  -1.785E-4   31 -32  59     u=134  imp:n=1   $ gap
2217  2  -6.74       32 -33  59     u=134  imp:n=1   $ clad
2218  134  -10.2144   -34  59       u=134  imp:n=1  vol=78.9937  $ fuel
2219  4  -1.785E-4   34 -35  59     u=134  imp:n=1   $ gap
2220  2  -6.74       35 -36  59     u=134  imp:n=1   $ clad
2221  134  -10.2144   -37  59       u=134  imp:n=1  vol=78.9937  $ fuel
2222  4  -1.785E-4   37 -38  59     u=134  imp:n=1   $ gap
2223  2  -6.74       38 -39  59     u=134  imp:n=1   $ clad
2224  134  -10.2144   -40  59       u=134  imp:n=1  vol=78.9937  $ fuel
2225  4  -1.785E-4   40 -41  59     u=134  imp:n=1   $ gap
2226  2  -6.74       41 -42  59     u=134  imp:n=1   $ clad
2227  134  -10.2144   -43  59       u=134  imp:n=1  vol=78.9937  $ fuel
2228  4  -1.785E-4   43 -44  59     u=134  imp:n=1   $ gap
2229  2  -6.74       44 -45  59     u=134  imp:n=1   $ clad
2230  134  -10.2144   -46  59       u=134  imp:n=1  vol=78.9937  $ fuel
2231  4  -1.785E-4   46 -47  59     u=134  imp:n=1   $ gap
2232  2  -6.74       47 -48  59     u=134  imp:n=1   $ clad
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2233  134  -10.2144   -49  59       u=134  imp:n=1  vol=78.9937  $ fuel
2234  4  -1.785E-4   49 -50  59     u=134  imp:n=1   $ gap
2235  2  -6.74       50 -51  59     u=134  imp:n=1   $ clad
2236  134  -10.2144   -52  59       u=134  imp:n=1  vol=78.9937  $ fuel
2237  4  -1.785E-4   52 -53  59     u=134  imp:n=1   $ gap
2238  2  -6.74       53 -54  59     u=134  imp:n=1   $ clad
2239  134  -10.2144   -55  59       u=134  imp:n=1  vol=78.9937  $ fuel
2240  4  -1.785E-4   55 -56  59     u=134  imp:n=1   $ gap
2241  2  -6.74       56 -57  59     u=134  imp:n=1   $ clad
2242  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=134  imp:n=1    $ D2O coolant
2243  3  -0.8143    -59 -60          u=134  imp:n=1    $ spacer
C      ***************************************************************
2244   141  -10.2144   -1  59        u=141  imp:n=1  vol=78.9937  $ fuel
2245   4  -1.785E-4   1 -2  59       u=141  imp:n=1   $ gap
2246   2  -6.74       2 -3  59       u=141  imp:n=1   $ clad
2247   141  -10.2144   -4  59        u=141  imp:n=1  vol=78.9937  $ fuel
2248   4  -1.785E-4   4 -5  59       u=141  imp:n=1   $ gap
2249   2  -6.74       5 -6  59       u=141  imp:n=1   $ clad
2250   141  -10.2144   -7  59        u=141  imp:n=1  vol=78.9937  $ fuel
2251   4  -1.785E-4   7 -8  59       u=141  imp:n=1   $ gap
2252   2  -6.74       8 -9  59       u=141  imp:n=1   $ clad
2253  141  -10.2144   -10   59      u=141  imp:n=1  vol=78.9937  $ fuel
2254  4  -1.785E-4   10 -11  59     u=141  imp:n=1   $ gap
2255  2  -6.74       11 -12  59     u=141  imp:n=1   $ clad
2256  141  -10.2144   -13  59       u=141  imp:n=1  vol=78.9937  $ fuel
2257  4  -1.785E-4   13 -14  59     u=141  imp:n=1   $ gap
2258  2  -6.74       14 -15  59     u=141  imp:n=1   $ clad
2259  141  -10.2144   -16  59       u=141  imp:n=1  vol=78.9937  $ fuel
2260  4  -1.785E-4   16 -17  59     u=141  imp:n=1   $ gap
2261  2  -6.74       17 -18  59     u=141  imp:n=1   $ clad
2262  141  -10.2144   -19  59       u=141  imp:n=1  vol=78.9937  $ fuel
2263  4  -1.785E-4   19 -20  59     u=141  imp:n=1   $ gap
2264  2  -6.74       20 -21  59     u=141  imp:n=1   $ clad
2265  141  -10.2144   -22  59       u=141  imp:n=1  vol=78.9937  $ fuel
2266  4  -1.785E-4   22 -23  59     u=141  imp:n=1   $ gap
2267  2  -6.74       23 -24  59     u=141  imp:n=1   $ clad
2268  141  -10.2144   -25  59       u=141  imp:n=1  vol=78.9937  $ fuel
2269  4  -1.785E-4   25 -26  59     u=141  imp:n=1   $ gap
2270  2  -6.74       26 -27  59     u=141  imp:n=1   $ clad
2271  141  -10.2144   -28  59       u=141  imp:n=1  vol=78.9937  $ fuel
2272  4  -1.785E-4   28 -29  59     u=141  imp:n=1   $ gap
2273  2  -6.74       29 -30  59     u=141  imp:n=1   $ clad
2274  141  -10.2144   -31  59       u=141  imp:n=1  vol=78.9937  $ fuel
2275  4  -1.785E-4   31 -32  59     u=141  imp:n=1   $ gap
2276  2  -6.74       32 -33  59     u=141  imp:n=1   $ clad
2277  141  -10.2144   -34  59       u=141  imp:n=1  vol=78.9937  $ fuel
2278  4  -1.785E-4   34 -35  59     u=141  imp:n=1   $ gap
2279  2  -6.74       35 -36  59     u=141  imp:n=1   $ clad
2280  141  -10.2144   -37  59       u=141  imp:n=1  vol=78.9937  $ fuel
2281  4  -1.785E-4   37 -38  59     u=141  imp:n=1   $ gap
2282  2  -6.74       38 -39  59     u=141  imp:n=1   $ clad
2283  141  -10.2144   -40  59       u=141  imp:n=1  vol=78.9937  $ fuel
2284  4  -1.785E-4   40 -41  59     u=141  imp:n=1   $ gap
2285  2  -6.74       41 -42  59     u=141  imp:n=1   $ clad
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2286  141  -10.2144   -43  59       u=141  imp:n=1  vol=78.9937  $ fuel
2287  4  -1.785E-4   43 -44  59     u=141  imp:n=1   $ gap
2288  2  -6.74       44 -45  59     u=141  imp:n=1   $ clad
2289  141  -10.2144   -46  59       u=141  imp:n=1  vol=78.9937  $ fuel
2290  4  -1.785E-4   46 -47  59     u=141  imp:n=1   $ gap
2291  2  -6.74       47 -48  59     u=141  imp:n=1   $ clad
2292  141  -10.2144   -49  59       u=141  imp:n=1  vol=78.9937  $ fuel
2293  4  -1.785E-4   49 -50  59     u=141  imp:n=1   $ gap
2294  2  -6.74       50 -51  59     u=141  imp:n=1   $ clad
2295  141  -10.2144   -52  59       u=141  imp:n=1  vol=78.9937  $ fuel
2296  4  -1.785E-4   52 -53  59     u=141  imp:n=1   $ gap
2297  2  -6.74       53 -54  59     u=141  imp:n=1   $ clad
2298  141  -10.2144   -55  59       u=141  imp:n=1  vol=78.9937  $ fuel
2299  4  -1.785E-4   55 -56  59     u=141  imp:n=1   $ gap
2300  2  -6.74       56 -57  59     u=141  imp:n=1   $ clad
2301  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=141  imp:n=1    $ D2O coolant
2302  3  -0.8143    -59 -60          u=141  imp:n=1    $ spacer
C      ************************************************************
2303   142  -10.2144   -1  59        u=142  imp:n=1  vol=78.9937  $ fuel
2304   4  -1.785E-4   1 -2  59       u=142  imp:n=1   $ gap
2305   2  -6.74       2 -3  59       u=142  imp:n=1   $ clad
2306   142  -10.2144   -4  59        u=142  imp:n=1  vol=78.9937  $ fuel
2307   4  -1.785E-4   4 -5  59       u=142  imp:n=1   $ gap
2308   2  -6.74       5 -6  59       u=142  imp:n=1   $ clad
2309   142  -10.2144   -7  59        u=142  imp:n=1  vol=78.9937  $ fuel
2310   4  -1.785E-4   7 -8  59       u=142  imp:n=1   $ gap
2311   2  -6.74       8 -9  59       u=142  imp:n=1   $ clad
2312  142  -10.2144   -10   59      u=142  imp:n=1  vol=78.9937  $ fuel
2313  4  -1.785E-4   10 -11  59     u=142  imp:n=1   $ gap
2314  2  -6.74       11 -12  59     u=142  imp:n=1   $ clad
2315  142  -10.2144   -13  59       u=142  imp:n=1  vol=78.9937  $ fuel
2316  4  -1.785E-4   13 -14  59     u=142  imp:n=1   $ gap
2317  2  -6.74       14 -15  59     u=142  imp:n=1   $ clad
2318  142  -10.2144   -16  59       u=142  imp:n=1  vol=78.9937  $ fuel
2319  4  -1.785E-4   16 -17  59     u=142  imp:n=1   $ gap
2320  2  -6.74       17 -18  59     u=142  imp:n=1   $ clad
2321  142  -10.2144   -19  59       u=142  imp:n=1  vol=78.9937  $ fuel
2322  4  -1.785E-4   19 -20  59     u=142  imp:n=1   $ gap
2323  2  -6.74       20 -21  59     u=142  imp:n=1   $ clad
2324  142  -10.2144   -22  59       u=142  imp:n=1  vol=78.9937  $ fuel
2325  4  -1.785E-4   22 -23  59     u=142  imp:n=1   $ gap
2326  2  -6.74       23 -24  59     u=142  imp:n=1   $ clad
2327  142  -10.2144   -25  59       u=142  imp:n=1  vol=78.9937  $ fuel
2328  4  -1.785E-4   25 -26  59     u=142  imp:n=1   $ gap
2329  2  -6.74       26 -27  59     u=142  imp:n=1   $ clad
2330  142  -10.2144   -28  59       u=142  imp:n=1  vol=78.9937  $ fuel
2331  4  -1.785E-4   28 -29  59     u=142  imp:n=1   $ gap
2332  2  -6.74       29 -30  59     u=142  imp:n=1   $ clad
2333  142  -10.2144   -31  59       u=142  imp:n=1  vol=78.9937  $ fuel
2334  4  -1.785E-4   31 -32  59     u=142  imp:n=1   $ gap
2335  2  -6.74       32 -33  59     u=142  imp:n=1   $ clad
2336  142  -10.2144   -34  59       u=142  imp:n=1  vol=78.9937  $ fuel
2337  4  -1.785E-4   34 -35  59     u=142  imp:n=1   $ gap
2338  2  -6.74       35 -36  59     u=142  imp:n=1   $ clad
```

```
2339  142  -10.2144   -37  59       u=142  imp:n=1  vol=78.9937  $ fuel
2340  4  -1.785E-4   37 -38  59     u=142  imp:n=1   $ gap
2341  2  -6.74       38 -39  59     u=142  imp:n=1   $ clad
2342  142  -10.2144   -40  59       u=142  imp:n=1  vol=78.9937  $ fuel
2343  4  -1.785E-4   40 -41  59     u=142  imp:n=1   $ gap
2344  2  -6.74       41 -42  59     u=142  imp:n=1   $ clad
2345  142  -10.2144   -43  59       u=142  imp:n=1  vol=78.9937  $ fuel
2346  4  -1.785E-4   43 -44  59     u=142  imp:n=1   $ gap
2347  2  -6.74       44 -45  59     u=142  imp:n=1   $ clad
2348  142  -10.2144   -46  59       u=142  imp:n=1  vol=78.9937  $ fuel
2349  4  -1.785E-4   46 -47  59     u=142  imp:n=1   $ gap
2350  2  -6.74       47 -48  59     u=142  imp:n=1   $ clad
2351  142  -10.2144   -49  59       u=142  imp:n=1  vol=78.9937  $ fuel
2352  4  -1.785E-4   49 -50  59     u=142  imp:n=1   $ gap
2353  2  -6.74       50 -51  59     u=142  imp:n=1   $ clad
2354  142  -10.2144   -52  59       u=142  imp:n=1  vol=78.9937  $ fuel
2355  4  -1.785E-4   52 -53  59     u=142  imp:n=1   $ gap
2356  2  -6.74       53 -54  59     u=142  imp:n=1   $ clad
2357  142  -10.2144   -55  59       u=142  imp:n=1  vol=78.9937  $ fuel
2358  4  -1.785E-4   55 -56  59     u=142  imp:n=1   $ gap
2359  2  -6.74       56 -57  59     u=142  imp:n=1   $ clad
2360  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=142  imp:n=1    $ D2O coolant
2361  3  -0.8143    -59 -60          u=142  imp:n=1    $ spacer
C      ************************************************************
2362   144  -10.2144   -1  59        u=144  imp:n=1  vol=78.9937  $ fuel
2363   4  -1.785E-4   1 -2  59       u=144  imp:n=1   $ gap
2364   2  -6.74       2 -3  59       u=144  imp:n=1   $ clad
2365   144  -10.2144   -4  59        u=144  imp:n=1  vol=78.9937  $ fuel
2366   4  -1.785E-4   4 -5  59       u=144  imp:n=1   $ gap
2367   2  -6.74       5 -6  59       u=144  imp:n=1   $ clad
2368   144  -10.2144   -7  59        u=144  imp:n=1  vol=78.9937  $ fuel
2369   4  -1.785E-4   7 -8  59       u=144  imp:n=1   $ gap
2370   2  -6.74       8 -9  59       u=144  imp:n=1   $ clad
2371  144  -10.2144   -10   59      u=144  imp:n=1  vol=78.9937  $ fuel
2372  4  -1.785E-4   10 -11  59     u=144  imp:n=1   $ gap
2373  2  -6.74       11 -12  59     u=144  imp:n=1   $ clad
2374  144  -10.2144   -13  59       u=144  imp:n=1  vol=78.9937  $ fuel
2375  4  -1.785E-4   13 -14  59     u=144  imp:n=1   $ gap
2376  2  -6.74       14 -15  59     u=144  imp:n=1   $ clad
2377  144  -10.2144   -16  59       u=144  imp:n=1  vol=78.9937  $ fuel
2378  4  -1.785E-4   16 -17  59     u=144  imp:n=1   $ gap
2379  2  -6.74       17 -18  59     u=144  imp:n=1   $ clad
2380  144  -10.2144   -19  59       u=144  imp:n=1  vol=78.9937  $ fuel
2381  4  -1.785E-4   19 -20  59     u=144  imp:n=1   $ gap
2382  2  -6.74       20 -21  59     u=144  imp:n=1   $ clad
2383  144  -10.2144   -22  59       u=144  imp:n=1  vol=78.9937  $ fuel
2384  4  -1.785E-4   22 -23  59     u=144  imp:n=1   $ gap
2385  2  -6.74       23 -24  59     u=144  imp:n=1   $ clad
2386  144  -10.2144   -25  59       u=144  imp:n=1  vol=78.9937  $ fuel
2387  4  -1.785E-4   25 -26  59     u=144  imp:n=1   $ gap
2388  2  -6.74       26 -27  59     u=144  imp:n=1   $ clad
2389  144  -10.2144   -28  59       u=144  imp:n=1  vol=78.9937  $ fuel
2390  4  -1.785E-4   28 -29  59     u=144  imp:n=1   $ gap
2391  2  -6.74       29 -30  59     u=144  imp:n=1   $ clad
```

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2392  144  -10.2144   -31  59       u=144  imp:n=1  vol=78.9937  $ fuel
2393  4  -1.785E-4   31 -32  59     u=144  imp:n=1   $ gap
2394  2  -6.74       32 -33  59     u=144  imp:n=1   $ clad
2395  144  -10.2144   -34  59       u=144  imp:n=1  vol=78.9937  $ fuel
2396  4  -1.785E-4   34 -35  59     u=144  imp:n=1   $ gap
2397  2  -6.74       35 -36  59     u=144  imp:n=1   $ clad
2398  144  -10.2144   -37  59       u=144  imp:n=1  vol=78.9937  $ fuel
2399  4  -1.785E-4   37 -38  59     u=144  imp:n=1   $ gap
2400  2  -6.74       38 -39  59     u=144  imp:n=1   $ clad
2401  144  -10.2144   -40  59       u=144  imp:n=1  vol=78.9937  $ fuel
2402  4  -1.785E-4   40 -41  59     u=144  imp:n=1   $ gap
2403  2  -6.74       41 -42  59     u=144  imp:n=1   $ clad
2404  144  -10.2144   -43  59       u=144  imp:n=1  vol=78.9937  $ fuel
2405  4  -1.785E-4   43 -44  59     u=144  imp:n=1   $ gap
2406  2  -6.74       44 -45  59     u=144  imp:n=1   $ clad
2407  144  -10.2144   -46  59       u=144  imp:n=1  vol=78.9937  $ fuel
2408  4  -1.785E-4   46 -47  59     u=144  imp:n=1   $ gap
2409  2  -6.74       47 -48  59     u=144  imp:n=1   $ clad
2410  144  -10.2144   -49  59       u=144  imp:n=1  vol=78.9937  $ fuel
2411  4  -1.785E-4   49 -50  59     u=144  imp:n=1   $ gap
2412  2  -6.74       50 -51  59     u=144  imp:n=1   $ clad
2413  144  -10.2144   -52  59       u=144  imp:n=1  vol=78.9937  $ fuel
2414  4  -1.785E-4   52 -53  59     u=144  imp:n=1   $ gap
2415  2  -6.74       53 -54  59     u=144  imp:n=1   $ clad
2416  144  -10.2144   -55  59       u=144  imp:n=1  vol=78.9937  $ fuel
2417  4  -1.785E-4   55 -56  59     u=144  imp:n=1   $ gap
2418  2  -6.74       56 -57  59     u=144  imp:n=1   $ clad
2419  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=144  imp:n=1    $ D2O coolant
2420  3  -0.8143    -59 -60          u=144  imp:n=1    $ spacer
C      ************************************************************
2421   151  -10.2144   -1  59        u=151  imp:n=1  vol=78.9937  $ fuel
2422   4  -1.785E-4   1 -2  59       u=151  imp:n=1   $ gap
2423   2  -6.74       2 -3  59       u=151  imp:n=1   $ clad
2424   151  -10.2144   -4  59        u=151  imp:n=1  vol=78.9937  $ fuel
2425   4  -1.785E-4   4 -5  59       u=151  imp:n=1   $ gap
2426   2  -6.74       5 -6  59       u=151  imp:n=1   $ clad
2427   151  -10.2144   -7  59        u=151  imp:n=1  vol=78.9937  $ fuel
2428   4  -1.785E-4   7 -8  59       u=151  imp:n=1   $ gap
2429   2  -6.74       8 -9  59       u=151  imp:n=1   $ clad
2430  151  -10.2144   -10   59      u=151  imp:n=1  vol=78.9937  $ fuel
2431  4  -1.785E-4   10 -11  59     u=151  imp:n=1   $ gap
2432  2  -6.74       11 -12  59     u=151  imp:n=1   $ clad
2433  151  -10.2144   -13  59       u=151  imp:n=1  vol=78.9937  $ fuel
2434  4  -1.785E-4   13 -14  59     u=151  imp:n=1   $ gap
2435  2  -6.74       14 -15  59     u=151  imp:n=1   $ clad
2436  151  -10.2144   -16  59       u=151  imp:n=1  vol=78.9937  $ fuel
2437  4  -1.785E-4   16 -17  59     u=151  imp:n=1   $ gap
2438  2  -6.74       17 -18  59     u=151  imp:n=1   $ clad
2439  151  -10.2144   -19  59       u=151  imp:n=1  vol=78.9937  $ fuel
2440  4  -1.785E-4   19 -20  59     u=151  imp:n=1   $ gap
2441  2  -6.74       20 -21  59     u=151  imp:n=1   $ clad
2442  151  -10.2144   -22  59       u=151  imp:n=1  vol=78.9937  $ fuel
2443  4  -1.785E-4   22 -23  59     u=151  imp:n=1   $ gap
2444  2  -6.74       23 -24  59     u=151  imp:n=1   $ clad
```

```
2445  151  -10.2144   -25  59       u=151  imp:n=1  vol=78.9937  $ fuel
2446  4  -1.785E-4   25 -26  59     u=151  imp:n=1   $ gap
2447  2  -6.74       26 -27  59     u=151  imp:n=1   $ clad
2448  151  -10.2144   -28  59       u=151  imp:n=1  vol=78.9937  $ fuel
2449  4  -1.785E-4   28 -29  59     u=151  imp:n=1   $ gap
2450  2  -6.74       29 -30  59     u=151  imp:n=1   $ clad
2451  151  -10.2144   -31  59       u=151  imp:n=1  vol=78.9937  $ fuel
2452  4  -1.785E-4   31 -32  59     u=151  imp:n=1   $ gap
2453  2  -6.74       32 -33  59     u=151  imp:n=1   $ clad
2454  151  -10.2144   -34  59       u=151  imp:n=1  vol=78.9937  $ fuel
2455  4  -1.785E-4   34 -35  59     u=151  imp:n=1   $ gap
2456  2  -6.74       35 -36  59     u=151  imp:n=1   $ clad
2457  151  -10.2144   -37  59       u=151  imp:n=1  vol=78.9937  $ fuel
2458  4  -1.785E-4   37 -38  59     u=151  imp:n=1   $ gap
2459  2  -6.74       38 -39  59     u=151  imp:n=1   $ clad
2460  151  -10.2144   -40  59       u=151  imp:n=1  vol=78.9937  $ fuel
2461  4  -1.785E-4   40 -41  59     u=151  imp:n=1   $ gap
2462  2  -6.74       41 -42  59     u=151  imp:n=1   $ clad
2463  151  -10.2144   -43  59       u=151  imp:n=1  vol=78.9937  $ fuel
2464  4  -1.785E-4   43 -44  59     u=151  imp:n=1   $ gap
2465  2  -6.74       44 -45  59     u=151  imp:n=1   $ clad
2466  151  -10.2144   -46  59       u=151  imp:n=1  vol=78.9937  $ fuel
2467  4  -1.785E-4   46 -47  59     u=151  imp:n=1   $ gap
2468  2  -6.74       47 -48  59     u=151  imp:n=1   $ clad
2469  151  -10.2144   -49  59       u=151  imp:n=1  vol=78.9937  $ fuel
2470  4  -1.785E-4   49 -50  59     u=151  imp:n=1   $ gap
2471  2  -6.74       50 -51  59     u=151  imp:n=1   $ clad
2472  151  -10.2144   -52  59       u=151  imp:n=1  vol=78.9937  $ fuel
2473  4  -1.785E-4   52 -53  59     u=151  imp:n=1   $ gap
2474  2  -6.74       53 -54  59     u=151  imp:n=1   $ clad
2475  151  -10.2144   -55  59       u=151  imp:n=1  vol=78.9937  $ fuel
2476  4  -1.785E-4   55 -56  59     u=151  imp:n=1   $ gap
2477  2  -6.74       56 -57  59     u=151  imp:n=1   $ clad
2478  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=151  imp:n=1    $ D2O coolant
2479  3  -0.8143    -59 -60          u=151  imp:n=1    $ spacer
C      ************************************************************
2480   152  -10.2144   -1  59        u=152  imp:n=1  vol=78.9937  $ fuel
2481   4  -1.785E-4   1 -2  59       u=152  imp:n=1   $ gap
2482   2  -6.74       2 -3  59       u=152  imp:n=1   $ clad
2483   152  -10.2144   -4  59        u=152  imp:n=1  vol=78.9937  $ fuel
2484   4  -1.785E-4   4 -5  59       u=152  imp:n=1   $ gap
2485   2  -6.74       5 -6  59       u=152  imp:n=1   $ clad
2486   152  -10.2144   -7  59        u=152  imp:n=1  vol=78.9937  $ fuel
2487   4  -1.785E-4   7 -8  59       u=152  imp:n=1   $ gap
2488   2  -6.74       8 -9  59       u=152  imp:n=1   $ clad
2489  152  -10.2144   -10   59      u=152  imp:n=1  vol=78.9937  $ fuel
2490  4  -1.785E-4   10 -11  59     u=152  imp:n=1   $ gap
2491  2  -6.74       11 -12  59     u=152  imp:n=1   $ clad
2492  152  -10.2144   -13  59       u=152  imp:n=1  vol=78.9937  $ fuel
2493  4  -1.785E-4   13 -14  59     u=152  imp:n=1   $ gap
2494  2  -6.74       14 -15  59     u=152  imp:n=1   $ clad
2495  152  -10.2144   -16  59       u=152  imp:n=1  vol=78.9937  $ fuel
2496  4  -1.785E-4   16 -17  59     u=152  imp:n=1   $ gap
2497  2  -6.74       17 -18  59     u=152  imp:n=1   $ clad
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2498  152  -10.2144   -19  59       u=152  imp:n=1  vol=78.9937  $ fuel
2499  4  -1.785E-4   19 -20  59     u=152  imp:n=1   $ gap
2500  2  -6.74       20 -21  59     u=152  imp:n=1   $ clad
2501  152  -10.2144   -22  59       u=152  imp:n=1  vol=78.9937  $ fuel
2502  4  -1.785E-4   22 -23  59     u=152  imp:n=1   $ gap
2503  2  -6.74       23 -24  59     u=152  imp:n=1   $ clad
2504  152  -10.2144   -25  59       u=152  imp:n=1  vol=78.9937  $ fuel
2505  4  -1.785E-4   25 -26  59     u=152  imp:n=1   $ gap
2506  2  -6.74       26 -27  59     u=152  imp:n=1   $ clad
2507  152  -10.2144   -28  59       u=152  imp:n=1  vol=78.9937  $ fuel
2508  4  -1.785E-4   28 -29  59     u=152  imp:n=1   $ gap
2509  2  -6.74       29 -30  59     u=152  imp:n=1   $ clad
2510  152  -10.2144   -31  59       u=152  imp:n=1  vol=78.9937  $ fuel
2511  4  -1.785E-4   31 -32  59     u=152  imp:n=1   $ gap
2512  2  -6.74       32 -33  59     u=152  imp:n=1   $ clad
2513  152  -10.2144   -34  59       u=152  imp:n=1  vol=78.9937  $ fuel
2514  4  -1.785E-4   34 -35  59     u=152  imp:n=1   $ gap
2515  2  -6.74       35 -36  59     u=152  imp:n=1   $ clad
2516  152  -10.2144   -37  59       u=152  imp:n=1  vol=78.9937  $ fuel
2517  4  -1.785E-4   37 -38  59     u=152  imp:n=1   $ gap
2518  2  -6.74       38 -39  59     u=152  imp:n=1   $ clad
2519  152  -10.2144   -40  59       u=152  imp:n=1  vol=78.9937  $ fuel
2520  4  -1.785E-4   40 -41  59     u=152  imp:n=1   $ gap
2521  2  -6.74       41 -42  59     u=152  imp:n=1   $ clad
2522  152  -10.2144   -43  59       u=152  imp:n=1  vol=78.9937  $ fuel
2523  4  -1.785E-4   43 -44  59     u=152  imp:n=1   $ gap
2524  2  -6.74       44 -45  59     u=152  imp:n=1   $ clad
2525  152  -10.2144   -46  59       u=152  imp:n=1  vol=78.9937  $ fuel
2526  4  -1.785E-4   46 -47  59     u=152  imp:n=1   $ gap
2527  2  -6.74       47 -48  59     u=152  imp:n=1   $ clad
2528  152  -10.2144   -49  59       u=152  imp:n=1  vol=78.9937  $ fuel
2529  4  -1.785E-4   49 -50  59     u=152  imp:n=1   $ gap
2530  2  -6.74       50 -51  59     u=152  imp:n=1   $ clad
2531  152  -10.2144   -52  59       u=152  imp:n=1  vol=78.9937  $ fuel
2532  4  -1.785E-4   52 -53  59     u=152  imp:n=1   $ gap
2533  2  -6.74       53 -54  59     u=152  imp:n=1   $ clad
2534  152  -10.2144   -55  59       u=152  imp:n=1  vol=78.9937  $ fuel
2535  4  -1.785E-4   55 -56  59     u=152  imp:n=1   $ gap
2536  2  -6.74       56 -57  59     u=152  imp:n=1   $ clad
2537  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=152  imp:n=1    $ D2O coolant
2538  3  -0.8143    -59 -60          u=152  imp:n=1    $ spacer
C      ***************************************************************
2539   154  -10.2144   -1  59        u=154  imp:n=1  vol=78.9937  $ fuel
2540   4  -1.785E-4   1 -2  59       u=154  imp:n=1   $ gap
2541   2  -6.74       2 -3  59       u=154  imp:n=1   $ clad
2542   154  -10.2144   -4  59        u=154  imp:n=1  vol=78.9937  $ fuel
2543   4  -1.785E-4   4 -5  59       u=154  imp:n=1   $ gap
2544   2  -6.74       5 -6  59       u=154  imp:n=1   $ clad
2545   154  -10.2144   -7  59        u=154  imp:n=1  vol=78.9937  $ fuel
2546   4  -1.785E-4   7 -8  59       u=154  imp:n=1   $ gap
2547   2  -6.74       8 -9  59       u=154  imp:n=1   $ clad
2548  154  -10.2144   -10   59      u=154  imp:n=1  vol=78.9937  $ fuel
2549  4  -1.785E-4   10 -11  59     u=154  imp:n=1   $ gap
2550  2  -6.74       11 -12  59     u=154  imp:n=1   $ clad
```

```
2551  154  -10.2144   -13  59       u=154  imp:n=1  vol=78.9937  $ fuel
2552  4  -1.785E-4   13 -14  59     u=154  imp:n=1   $ gap
2553  2  -6.74       14 -15  59     u=154  imp:n=1   $ clad
2554  154  -10.2144   -16  59       u=154  imp:n=1  vol=78.9937  $ fuel
2555  4  -1.785E-4   16 -17  59     u=154  imp:n=1   $ gap
2556  2  -6.74       17 -18  59     u=154  imp:n=1   $ clad
2557  154  -10.2144   -19  59       u=154  imp:n=1  vol=78.9937  $ fuel
2558  4  -1.785E-4   19 -20  59     u=154  imp:n=1   $ gap
2559  2  -6.74       20 -21  59     u=154  imp:n=1   $ clad
2560  154  -10.2144   -22  59       u=154  imp:n=1  vol=78.9937  $ fuel
2561  4  -1.785E-4   22 -23  59     u=154  imp:n=1   $ gap
2562  2  -6.74       23 -24  59     u=154  imp:n=1   $ clad
2563  154  -10.2144   -25  59       u=154  imp:n=1  vol=78.9937  $ fuel
2564  4  -1.785E-4   25 -26  59     u=154  imp:n=1   $ gap
2565  2  -6.74       26 -27  59     u=154  imp:n=1   $ clad
2566  154  -10.2144   -28  59       u=154  imp:n=1  vol=78.9937  $ fuel
2567  4  -1.785E-4   28 -29  59     u=154  imp:n=1   $ gap
2568  2  -6.74       29 -30  59     u=154  imp:n=1   $ clad
2569  154  -10.2144   -31  59       u=154  imp:n=1  vol=78.9937  $ fuel
2570  4  -1.785E-4   31 -32  59     u=154  imp:n=1   $ gap
2571  2  -6.74       32 -33  59     u=154  imp:n=1   $ clad
2572  154  -10.2144   -34  59       u=154  imp:n=1  vol=78.9937  $ fuel
2573  4 -1.785E-4   34 -35  59     u=154  imp:n=1   $ gap
2574  2  -6.74       35 -36  59     u=154  imp:n=1   $ clad
2575  154  -10.2144   -37  59       u=154  imp:n=1  vol=78.9937  $ fuel
2576  4  -1.785E-4   37 -38  59     u=154  imp:n=1   $ gap
2577  2  -6.74       38 -39  59     u=154  imp:n=1   $ clad
2578  154  -10.2144   -40  59       u=154  imp:n=1  vol=78.9937  $ fuel
2579  4  -1.785E-4   40 -41  59     u=154  imp:n=1   $ gap
2580  2  -6.74       41 -42  59     u=154  imp:n=1   $ clad
2581  154  -10.2144   -43  59       u=154  imp:n=1  vol=78.9937  $ fuel
2582  4  -1.785E-4   43 -44  59     u=154  imp:n=1   $ gap
2583  2  -6.74       44 -45  59     u=154  imp:n=1   $ clad
2584  154  -10.2144   -46  59       u=154  imp:n=1  vol=78.9937  $ fuel
2585  4  -1.785E-4   46 -47  59     u=154  imp:n=1   $ gap
2586  2  -6.74       47 -48  59     u=154  imp:n=1   $ clad
2587  154  -10.2144   -49  59       u=154  imp:n=1  vol=78.9937  $ fuel
2588  4  -1.785E-4   49 -50  59     u=154  imp:n=1   $ gap
2589  2  -6.74       50 -51  59     u=154  imp:n=1   $ clad
2590  154  -10.2144   -52  59       u=154  imp:n=1  vol=78.9937  $ fuel
2591  4  -1.785E-4   52 -53  59     u=154  imp:n=1   $ gap
2592  2  -6.74       53 -54  59     u=154  imp:n=1   $ clad
2593  154  -10.2144   -55  59       u=154  imp:n=1  vol=78.9937  $ fuel
2594  4  -1.785E-4   55 -56  59     u=154  imp:n=1   $ gap
2595  2  -6.74       56 -57  59     u=154  imp:n=1   $ clad
2596  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=154  imp:n=1    $ D2O coolant
2597  3  -0.8143    -59 -60          u=154  imp:n=1    $ spacer
C      ************************************************************
2598   161  -10.2144   -1  59       u=161  imp:n=1  vol=78.9937  $ fuel
2599   4  -1.785E-4   1 -2  59      u=161  imp:n=1   $ gap
2600   2  -6.74       2 -3  59      u=161  imp:n=1   $ clad
2601   161  -10.2144   -4  59       u=161  imp:n=1  vol=78.9937  $ fuel
2602   4  -1.785E-4   4 -5  59      u=161  imp:n=1   $ gap
2603   2  -6.74       5 -6  59      u=161  imp:n=1   $ clad
```

```
2604   161  -10.2144   -7  59        u=161  imp:n=1  vol=78.9937  $ fuel
2605   4  -1.785E-4   7 -8  59       u=161  imp:n=1   $ gap
2606   2  -6.74       8 -9  59       u=161  imp:n=1   $ clad
2607  161  -10.2144   -10   59      u=161  imp:n=1  vol=78.9937  $ fuel
2608  4  -1.785E-4   10 -11  59     u=161  imp:n=1   $ gap
2609  2  -6.74       11 -12  59     u=161  imp:n=1   $ clad
2610  161  -10.2144   -13  59      u=161  imp:n=1  vol=78.9937  $ fuel
2611  4  -1.785E-4   13 -14  59     u=161  imp:n=1   $ gap
2612  2  -6.74       14 -15  59     u=161  imp:n=1   $ clad
2613  161  -10.2144   -16  59      u=161  imp:n=1  vol=78.9937  $ fuel
2614  4  -1.785E-4   16 -17  59     u=161  imp:n=1   $ gap
2615  2  -6.74       17 -18  59     u=161  imp:n=1   $ clad
2616  161  -10.2144   -19  59      u=161  imp:n=1  vol=78.9937  $ fuel
2617  4  -1.785E-4   19 -20  59     u=161  imp:n=1   $ gap
2618  2  -6.74       20 -21  59     u=161  imp:n=1   $ clad
2619  161  -10.2144   -22  59      u=161  imp:n=1  vol=78.9937  $ fuel
2620  4  -1.785E-4   22 -23  59     u=161  imp:n=1   $ gap
2621  2  -6.74       23 -24  59     u=161  imp:n=1   $ clad
2622  161  -10.2144   -25  59      u=161  imp:n=1  vol=78.9937  $ fuel
2623  4  -1.785E-4   25 -26  59     u=161  imp:n=1   $ gap
2624  2  -6.74       26 -27  59     u=161  imp:n=1   $ clad
2625  161  -10.2144   -28  59      u=161  imp:n=1  vol=78.9937  $ fuel
2626  4  -1.785E-4   28 -29  59     u=161  imp:n=1   $ gap
2627  2  -6.74       29 -30  59     u=161  imp:n=1   $ clad
2628  161  -10.2144   -31  59      u=161  imp:n=1  vol=78.9937  $ fuel
2629  4  -1.785E-4   31 -32  59     u=161  imp:n=1   $ gap
2630  2  -6.74       32 -33  59     u=161  imp:n=1   $ clad
2631  161  -10.2144   -34  59      u=161  imp:n=1  vol=78.9937  $ fuel
2632  4  -1.785E-4   34 -35  59     u=161  imp:n=1   $ gap
2633  2  -6.74       35 -36  59     u=161  imp:n=1   $ clad
2634  161  -10.2144   -37  59      u=161  imp:n=1  vol=78.9937  $ fuel
2635  4  -1.785E-4   37 -38  59     u=161  imp:n=1   $ gap
2636  2  -6.74       38 -39  59     u=161  imp:n=1   $ clad
2637  161  -10.2144   -40  59      u=161  imp:n=1  vol=78.9937  $ fuel
2638  4  -1.785E-4   40 -41  59     u=161  imp:n=1   $ gap
2639  2  -6.74       41 -42  59     u=161  imp:n=1   $ clad
2640  161  -10.2144   -43  59      u=161  imp:n=1  vol=78.9937  $ fuel
2641  4  -1.785E-4   43 -44  59     u=161  imp:n=1   $ gap
2642  2  -6.74       44 -45  59     u=161  imp:n=1   $ clad
2643  161  -10.2144   -46  59      u=161  imp:n=1  vol=78.9937  $ fuel
2644  4  -1.785E-4   46 -47  59     u=161  imp:n=1   $ gap
2645  2  -6.74       47 -48  59     u=161  imp:n=1   $ clad
2646  161  -10.2144   -49  59      u=161  imp:n=1  vol=78.9937  $ fuel
2647  4  -1.785E-4   49 -50  59     u=161  imp:n=1   $ gap
2648  2  -6.74       50 -51  59     u=161  imp:n=1   $ clad
2649  161  -10.2144   -52  59      u=161  imp:n=1  vol=78.9937  $ fuel
2650  4  -1.785E-4   52 -53  59     u=161  imp:n=1   $ gap
2651  2  -6.74       53 -54  59     u=161  imp:n=1   $ clad
2652  161  -10.2144   -55  59      u=161  imp:n=1  vol=78.9937  $ fuel
2653  4  -1.785E-4   55 -56  59     u=161  imp:n=1   $ gap
2654  2  -6.74       56 -57  59     u=161  imp:n=1   $ clad
2655  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=161  imp:n=1    $ D2O coolant
2656  3  -0.8143    -59 -60          u=161  imp:n=1    $ spacer
C      ************************************************************
```

```
2657   162  -10.2144   -1  59       u=162  imp:n=1  vol=78.9937  $ fuel
2658   4  -1.785E-4   1 -2  59      u=162  imp:n=1   $ gap
2659   2  -6.74       2 -3  59      u=162  imp:n=1   $ clad
2660   162  -10.2144   -4  59       u=162  imp:n=1  vol=78.9937  $ fuel
2661   4  -1.785E-4   4 -5  59      u=162  imp:n=1   $ gap
2662   2  -6.74       5 -6  59      u=162  imp:n=1   $ clad
2663   162  -10.2144   -7  59       u=162  imp:n=1  vol=78.9937  $ fuel
2664   4  -1.785E-4   7 -8  59      u=162  imp:n=1   $ gap
2665   2  -6.74       8 -9  59      u=162  imp:n=1   $ clad
2666  162  -10.2144   -10   59     u=162  imp:n=1  vol=78.9937  $ fuel
2667  4  -1.785E-4   10 -11  59    u=162  imp:n=1   $ gap
2668  2  -6.74       11 -12  59    u=162  imp:n=1   $ clad
2669  162  -10.2144   -13  59      u=162  imp:n=1  vol=78.9937  $ fuel
2670  4  -1.785E-4   13 -14  59    u=162  imp:n=1   $ gap
2671  2  -6.74       14 -15  59    u=162  imp:n=1   $ clad
2672  162  -10.2144   -16  59      u=162  imp:n=1  vol=78.9937  $ fuel
2673  4  -1.785E-4   16 -17  59    u=162  imp:n=1   $ gap
2674  2  -6.74       17 -18  59    u=162  imp:n=1   $ clad
2675  162  -10.2144   -19  59      u=162  imp:n=1  vol=78.9937  $ fuel
2676  4  -1.785E-4   19 -20  59    u=162  imp:n=1   $ gap
2677  2  -6.74       20 -21  59    u=162  imp:n=1   $ clad
2678  162  -10.2144   -22  59      u=162  imp:n=1  vol=78.9937  $ fuel
2679  4  -1.785E-4   22 -23  59    u=162  imp:n=1   $ gap
2680  2  -6.74       23 -24  59    u=162  imp:n=1   $ clad
2681  162  -10.2144   -25  59      u=162  imp:n=1  vol=78.9937  $ fuel
2682  4  -1.785E-4   25 -26  59    u=162  imp:n=1   $ gap
2683  2  -6.74       26 -27  59    u=162  imp:n=1   $ clad
2684  162  -10.2144   -28  59      u=162  imp:n=1  vol=78.9937  $ fuel
2685  4  -1.785E-4   28 -29  59    u=162  imp:n=1   $ gap
2686  2  -6.74       29 -30  59    u=162  imp:n=1   $ clad
2687  162  -10.2144   -31  59      u=162  imp:n=1  vol=78.9937  $ fuel
2688  4  -1.785E-4   31 -32  59    u=162  imp:n=1   $ gap
2689  2  -6.74       32 -33  59    u=162  imp:n=1   $ clad
2690  162  -10.2144   -34  59      u=162  imp:n=1  vol=78.9937  $ fuel
2691  4  -1.785E-4   34 -35  59    u=162  imp:n=1   $ gap
2692  2  -6.74       35 -36  59    u=162  imp:n=1   $ clad
2693  162  -10.2144   -37  59      u=162  imp:n=1  vol=78.9937  $ fuel
2694  4  -1.785E-4   37 -38  59    u=162  imp:n=1   $ gap
2695  2  -6.74       38 -39  59    u=162  imp:n=1   $ clad
2696  162  -10.2144   -40  59      u=162  imp:n=1  vol=78.9937  $ fuel
2697  4  -1.785E-4   40 -41  59    u=162  imp:n=1   $ gap
2698  2  -6.74       41 -42  59    u=162  imp:n=1   $ clad
2699  162  -10.2144   -43  59      u=162  imp:n=1  vol=78.9937  $ fuel
2700  4  -1.785E-4   43 -44  59    u=162  imp:n=1   $ gap
2701  2  -6.74       44 -45  59    u=162  imp:n=1   $ clad
2702  162  -10.2144   -46  59      u=162  imp:n=1  vol=78.9937  $ fuel
2703  4  -1.785E-4   46 -47  59    u=162  imp:n=1   $ gap
2704  2  -6.74       47 -48  59    u=162  imp:n=1   $ clad
2705  162  -10.2144   -49  59      u=162  imp:n=1  vol=78.9937  $ fuel
2706  4  -1.785E-4   49 -50  59    u=162  imp:n=1   $ gap
2707  2  -6.74       50 -51  59    u=162  imp:n=1   $ clad
2708  162  -10.2144   -52  59      u=162  imp:n=1  vol=78.9937  $ fuel
2709  4  -1.785E-4   52 -53  59    u=162  imp:n=1   $ gap
2710  2  -6.74       53 -54  59    u=162  imp:n=1   $ clad
2711  162  -10.2144   -55  59      u=162  imp:n=1  vol=78.9937  $ fuel
```

```
2712  4  -1.785E-4   55 -56  59     u=162  imp:n=1   $ gap
2713  2  -6.74       56 -57  59     u=162  imp:n=1   $ clad
2714  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=162  imp:n=1    $ D2O coolant
2715  3  -0.8143    -59 -60          u=162  imp:n=1    $ spacer
C      ************************************************************
2716   164  -10.2144   -1  59        u=164  imp:n=1  vol=78.9937  $ fuel
2717   4  -1.785E-4   1 -2  59       u=164  imp:n=1   $ gap
2718   2  -6.74       2 -3  59       u=164  imp:n=1   $ clad
2719   164  -10.2144   -4  59        u=164  imp:n=1  vol=78.9937  $ fuel
2720   4  -1.785E-4   4 -5  59       u=164  imp:n=1   $ gap
2721   2  -6.74       5 -6  59       u=164  imp:n=1   $ clad
2722   164  -10.2144   -7  59        u=164  imp:n=1  vol=78.9937  $ fuel
2723   4  -1.785E-4   7 -8  59       u=164  imp:n=1   $ gap
2724   2  -6.74       8 -9  59       u=164  imp:n=1   $ clad
2725  164  -10.2144   -10   59      u=164  imp:n=1  vol=78.9937  $ fuel
2726  4  -1.785E-4   10 -11  59     u=164  imp:n=1   $ gap
2727  2  -6.74       11 -12  59     u=164  imp:n=1   $ clad
2728  164  -10.2144   -13  59      u=164  imp:n=1  vol=78.9937  $ fuel
2729  4  -1.785E-4   13 -14  59     u=164  imp:n=1   $ gap
2730  2  -6.74       14 -15  59     u=164  imp:n=1   $ clad
2731  164  -10.2144   -16  59      u=164  imp:n=1  vol=78.9937  $ fuel
2732  4  -1.785E-4   16 -17  59     u=164  imp:n=1   $ gap
2733  2  -6.74       17 -18  59     u=164  imp:n=1   $ clad
2734  164  -10.2144   -19  59      u=164  imp:n=1  vol=78.9937  $ fuel
2735  4  -1.785E-4   19 -20  59     u=164  imp:n=1   $ gap
2736  2  -6.74       20 -21  59     u=164  imp:n=1   $ clad
2737  164  -10.2144   -22  59      u=164  imp:n=1  vol=78.9937  $ fuel
2738  4  -1.785E-4   22 -23  59     u=164  imp:n=1   $ gap
2739  2  -6.74       23 -24  59     u=164  imp:n=1   $ clad
2740  164  -10.2144   -25  59      u=164  imp:n=1  vol=78.9937  $ fuel
2741  4  -1.785E-4   25 -26  59     u=164  imp:n=1   $ gap
2742  2  -6.74       26 -27  59     u=164  imp:n=1   $ clad
2743  164  -10.2144   -28  59      u=164  imp:n=1  vol=78.9937  $ fuel
2744  4  -1.785E-4   28 -29  59     u=164  imp:n=1   $ gap
2745  2  -6.74       29 -30  59     u=164  imp:n=1   $ clad
2746  164  -10.2144   -31  59      u=164  imp:n=1  vol=78.9937  $ fuel
2747  4  -1.785E-4   31 -32  59     u=164  imp:n=1   $ gap
2748  2  -6.74       32 -33  59     u=164  imp:n=1   $ clad
2749  164  -10.2144   -34  59      u=164  imp:n=1  vol=78.9937  $ fuel
2750  4  -1.785E-4   34 -35  59     u=164  imp:n=1   $ gap
2751  2  -6.74       35 -36  59     u=164  imp:n=1   $ clad
2752  164  -10.2144   -37  59      u=164  imp:n=1  vol=78.9937  $ fuel
2753  4  -1.785E-4   37 -38  59     u=164  imp:n=1   $ gap
2754  2  -6.74       38 -39  59     u=164  imp:n=1   $ clad
2755  164  -10.2144   -40  59      u=164  imp:n=1  vol=78.9937  $ fuel
2756  4  -1.785E-4   40 -41  59     u=164  imp:n=1   $ gap
2757  2  -6.74       41 -42  59     u=164  imp:n=1   $ clad
2758  164  -10.2144   -43  59      u=164  imp:n=1  vol=78.9937  $ fuel
2759  4  -1.785E-4   43 -44  59     u=164  imp:n=1   $ gap
2760  2  -6.74       44 -45  59     u=164  imp:n=1   $ clad
2761  164  -10.2144   -46  59      u=164  imp:n=1  vol=78.9937  $ fuel
2762  4  -1.785E-4   46 -47  59     u=164  imp:n=1   $ gap
2763  2  -6.74       47 -48  59     u=164  imp:n=1   $ clad
2764  164  -10.2144   -49  59      u=164  imp:n=1  vol=78.9937  $ fuel
```

```
2765  4  -1.785E-4   49 -50  59     u=164  imp:n=1   $ gap
2766  2  -6.74       50 -51  59     u=164  imp:n=1   $ clad
2767  164  -10.2144   -52  59       u=164  imp:n=1  vol=78.9937  $ fuel
2768  4  -1.785E-4   52 -53  59     u=164  imp:n=1   $ gap
2769  2  -6.74       53 -54  59     u=164  imp:n=1   $ clad
2770  164  -10.2144   -55  59       u=164  imp:n=1  vol=78.9937  $ fuel
2771  4  -1.785E-4   55 -56  59     u=164  imp:n=1   $ gap
2772  2  -6.74       56 -57  59     u=164  imp:n=1   $ clad
2773  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=164  imp:n=1    $ D2O coolant
2774  3  -0.8143    -59 -60          u=164  imp:n=1    $ spacer
C      ****************************************************************
2775   171  -10.2144   -1  59        u=171  imp:n=1  vol=78.9937  $ fuel
2776   4  -1.785E-4   1 -2  59       u=171  imp:n=1   $ gap
2777   2  -6.74       2 -3  59       u=171  imp:n=1   $ clad
2778   171  -10.2144   -4  59        u=171  imp:n=1  vol=78.9937  $ fuel
2779   4  -1.785E-4   4 -5  59       u=171  imp:n=1   $ gap
2780   2  -6.74       5 -6  59       u=171  imp:n=1   $ clad
2781   171  -10.2144   -7  59        u=171  imp:n=1  vol=78.9937  $ fuel
2782   4  -1.785E-4   7 -8  59       u=171  imp:n=1   $ gap
2783   2  -6.74       8 -9  59       u=171  imp:n=1   $ clad
2784  171  -10.2144   -10   59      u=171  imp:n=1  vol=78.9937  $ fuel
2785  4  -1.785E-4   10 -11  59     u=171  imp:n=1   $ gap
2786  2  -6.74       11 -12  59     u=171  imp:n=1   $ clad
2787  171  -10.2144   -13  59       u=171  imp:n=1  vol=78.9937  $ fuel
2788  4  -1.785E-4   13 -14  59     u=171  imp:n=1   $ gap
2789  2  -6.74       14 -15  59     u=171  imp:n=1   $ clad
2790  171  -10.2144   -16  59       u=171  imp:n=1  vol=78.9937  $ fuel
2791  4  -1.785E-4   16 -17  59     u=171  imp:n=1   $ gap
2792  2  -6.74       17 -18  59     u=171  imp:n=1   $ clad
2793  171  -10.2144   -19  59       u=171  imp:n=1  vol=78.9937  $ fuel
2794  4  -1.785E-4   19 -20  59     u=171  imp:n=1   $ gap
2795  2  -6.74       20 -21  59     u=171  imp:n=1   $ clad
2796  171  -10.2144   -22  59       u=171  imp:n=1  vol=78.9937  $ fuel
2797  4  -1.785E-4   22 -23  59     u=171  imp:n=1   $ gap
2798  2  -6.74       23 -24  59     u=171  imp:n=1   $ clad
2799  171  -10.2144   -25  59       u=171  imp:n=1  vol=78.9937  $ fuel
2800  4  -1.785E-4   25 -26  59     u=171  imp:n=1   $ gap
2801  2  -6.74       26 -27  59     u=171  imp:n=1   $ clad
2802  171  -10.2144   -28  59       u=171  imp:n=1  vol=78.9937  $ fuel
2803  4  -1.785E-4   28 -29  59     u=171  imp:n=1   $ gap
2804  2  -6.74       29 -30  59     u=171  imp:n=1   $ clad
2805  171  -10.2144   -31  59       u=171  imp:n=1  vol=78.9937  $ fuel
2806  4  -1.785E-4   31 -32  59     u=171  imp:n=1   $ gap
2807  2  -6.74       32 -33  59     u=171  imp:n=1   $ clad
2808  171  -10.2144   -34  59       u=171  imp:n=1  vol=78.9937  $ fuel
2809  4  -1.785E-4   34 -35  59     u=171  imp:n=1   $ gap
2810  2  -6.74       35 -36  59     u=171  imp:n=1   $ clad
2811  171  -10.2144   -37  59       u=171  imp:n=1  vol=78.9937  $ fuel
2812 4  -1.785E-4   37 -38  59     u=171  imp:n=1   $ gap
2813  2  -6.74       38 -39  59     u=171  imp:n=1   $ clad
2814  171  -10.2144   -40  59       u=171  imp:n=1  vol=78.9937  $ fuel
2815  4  -1.785E-4   40 -41  59     u=171  imp:n=1   $ gap
2816  2  -6.74       41 -42  59     u=171  imp:n=1   $ clad
2817  171  -10.2144   -43  59       u=171  imp:n=1  vol=78.9937  $ fuel
```

```
2818  4  -1.785E-4   43 -44  59     u=171  imp:n=1   $ gap
2819  2  -6.74       44 -45  59     u=171  imp:n=1   $ clad
2820  171  -10.2144   -46  59       u=171  imp:n=1  vol=78.9937  $ fuel
2821  4  -1.785E-4   46 -47  59     u=171  imp:n=1   $ gap
2822  2  -6.74       47 -48  59     u=171  imp:n=1   $ clad
2823  171  -10.2144   -49  59       u=171  imp:n=1  vol=78.9937  $ fuel
2824  4  -1.785E-4   49 -50  59     u=171  imp:n=1   $ gap
2825  2  -6.74       50 -51  59     u=171  imp:n=1   $ clad
2826  171  -10.2144   -52  59       u=171  imp:n=1  vol=78.9937  $ fuel
2827  4  -1.785E-4   52 -53  59     u=171  imp:n=1   $ gap
2828  2  -6.74       53 -54  59     u=171  imp:n=1   $ clad
2829  171  -10.2144   -55  59       u=171  imp:n=1  vol=78.9937  $ fuel
2830  4  -1.785E-4   55 -56  59     u=171  imp:n=1   $ gap
2831  2  -6.74       56 -57  59     u=171  imp:n=1   $ clad
2832  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=171  imp:n=1    $ D2O coolant
2833  3  -0.8143    -59 -60          u=171  imp:n=1    $ spacer
C      ************************************************************
2834   172  -10.2144   -1  59        u=172  imp:n=1  vol=78.9937  $ fuel
2835   4  -1.785E-4   1 -2  59       u=172  imp:n=1   $ gap
2836   2  -6.74       2 -3  59       u=172  imp:n=1   $ clad
2837   172  -10.2144   -4  59        u=172  imp:n=1  vol=78.9937  $ fuel
2838   4  -1.785E-4   4 -5  59       u=172  imp:n=1   $ gap
2839   2  -6.74       5 -6  59       u=172  imp:n=1   $ clad
2840   172  -10.2144   -7  59        u=172  imp:n=1  vol=78.9937  $ fuel
2841   4  -1.785E-4   7 -8  59       u=172  imp:n=1   $ gap
2842   2  -6.74       8 -9  59       u=172  imp:n=1   $ clad
2843  172  -10.2144   -10   59      u=172  imp:n=1  vol=78.9937  $ fuel
2844  4  -1.785E-4   10 -11  59     u=172  imp:n=1   $ gap
2845  2  -6.74       11 -12  59     u=172  imp:n=1   $ clad
2846  172  -10.2144   -13  59       u=172  imp:n=1  vol=78.9937  $ fuel
2847  4  -1.785E-4   13 -14  59     u=172  imp:n=1   $ gap
2848  2  -6.74       14 -15  59     u=172  imp:n=1   $ clad
2849  172  -10.2144   -16  59       u=172  imp:n=1  vol=78.9937  $ fuel
2850  4  -1.785E-4   16 -17  59     u=172  imp:n=1   $ gap
2851  2  -6.74       17 -18  59     u=172  imp:n=1   $ clad
2852  172  -10.2144   -19  59       u=172  imp:n=1  vol=78.9937  $ fuel
2853  4  -1.785E-4   19 -20  59     u=172  imp:n=1   $ gap
2854  2  -6.74       20 -21  59     u=172  imp:n=1   $ clad
2855  172  -10.2144   -22  59       u=172  imp:n=1  vol=78.9937  $ fuel
2856  4  -1.785E-4   22 -23  59     u=172  imp:n=1   $ gap
2857  2  -6.74       23 -24  59     u=172  imp:n=1   $ clad
2858  172  -10.2144   -25  59       u=172  imp:n=1  vol=78.9937  $ fuel
2859  4  -1.785E-4   25 -26  59     u=172  imp:n=1   $ gap
2860  2  -6.74       26 -27  59     u=172  imp:n=1   $ clad
2861  172  -10.2144   -28  59       u=172  imp:n=1  vol=78.9937  $ fuel
2862  4  -1.785E-4   28 -29  59     u=172  imp:n=1   $ gap
2863  2  -6.74       29 -30  59     u=172  imp:n=1   $ clad
2864  172  -10.2144   -31  59       u=172  imp:n=1  vol=78.9937  $ fuel
2865  4  -1.785E-4   31 -32  59     u=172  imp:n=1   $ gap
2866  2  -6.74       32 -33  59     u=172  imp:n=1   $ clad
2867  172  -10.2144   -34  59       u=172  imp:n=1  vol=78.9937  $ fuel
2868  4  -1.785E-4   34 -35  59     u=172  imp:n=1   $ gap
2869  2  -6.74       35 -36  59     u=172  imp:n=1   $ clad
2870  172  -10.2144   -37  59       u=172  imp:n=1  vol=78.9937  $ fuel
```

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2871  4  -1.785E-4   37 -38  59     u=172  imp:n=1   $ gap
2872  2  -6.74       38 -39  59     u=172  imp:n=1   $ clad
2873  172  -10.2144   -40  59       u=172  imp:n=1  vol=78.9937  $ fuel
2874  4  -1.785E-4   40 -41  59     u=172  imp:n=1   $ gap
2875  2  -6.74       41 -42  59     u=172  imp:n=1   $ clad
2876  172  -10.2144   -43  59       u=172  imp:n=1  vol=78.9937  $ fuel
2877  4  -1.785E-4   43 -44  59     u=172  imp:n=1   $ gap
2878  2  -6.74       44 -45  59     u=172  imp:n=1   $ clad
2879  172  -10.2144   -46  59       u=172  imp:n=1  vol=78.9937  $ fuel
2880  4  -1.785E-4   46 -47  59     u=172  imp:n=1   $ gap
2881  2  -6.74       47 -48  59     u=172  imp:n=1   $ clad
2882  172  -10.2144   -49  59       u=172  imp:n=1  vol=78.9937  $ fuel
2883  4  -1.785E-4   49 -50  59     u=172  imp:n=1   $ gap
2884  2  -6.74       50 -51  59     u=172  imp:n=1   $ clad
2885  172  -10.2144   -52  59       u=172  imp:n=1  vol=78.9937  $ fuel
2886  4  -1.785E-4   52 -53  59     u=172  imp:n=1   $ gap
2887  2  -6.74       53 -54  59     u=172  imp:n=1   $ clad
2888  172  -10.2144   -55  59       u=172  imp:n=1  vol=78.9937  $ fuel
2889  4  -1.785E-4   55 -56  59     u=172  imp:n=1   $ gap
2890  2  -6.74       56 -57  59     u=172  imp:n=1   $ clad
2891  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=172  imp:n=1    $ D2O coolant
2892  3  -0.8143    -59 -60          u=172  imp:n=1    $ spacer
C      ********************************************************************
2893   174  -10.2144   -1  59        u=174  imp:n=1  vol=78.9937  $ fuel
2894   4  -1.785E-4   1 -2  59       u=174  imp:n=1   $ gap
2895   2  -6.74       2 -3  59       u=174  imp:n=1   $ clad
2896   174  -10.2144   -4  59       u=174  imp:n=1  vol=78.9937  $ fuel
2897   4  -1.785E-4   4 -5  59       u=174  imp:n=1   $ gap
2898   2  -6.74       5 -6  59       u=174  imp:n=1   $ clad
2899   174  -10.2144   -7  59       u=174  imp:n=1  vol=78.9937  $ fuel
2900   4  -1.785E-4   7 -8  59       u=174  imp:n=1   $ gap
2901   2  -6.74       8 -9  59       u=174  imp:n=1   $ clad
2902  174  -10.2144   -10   59      u=174  imp:n=1  vol=78.9937  $ fuel
2903  4  -1.785E-4   10 -11  59     u=174  imp:n=1   $ gap
2904  2  -6.74       11 -12  59     u=174  imp:n=1   $ clad
2905  174  -10.2144   -13  59       u=174  imp:n=1  vol=78.9937  $ fuel
2906  4  -1.785E-4   13 -14  59     u=174  imp:n=1   $ gap
2907  2  -6.74       14 -15  59     u=174  imp:n=1   $ clad
2908  174  -10.2144   -16  59       u=174  imp:n=1  vol=78.9937  $ fuel
2909  4  -1.785E-4   16 -17  59     u=174  imp:n=1   $ gap
2910  2  -6.74       17 -18  59     u=174  imp:n=1   $ clad
2911  174  -10.2144   -19  59       u=174  imp:n=1  vol=78.9937  $ fuel
2912  4  -1.785E-4   19 -20  59     u=174  imp:n=1   $ gap
2913  2  -6.74       20 -21  59     u=174  imp:n=1   $ clad
2914  174  -10.2144   -22  59       u=174  imp:n=1  vol=78.9937  $ fuel
2915  4  -1.785E-4   22 -23  59     u=174  imp:n=1   $ gap
2916  2  -6.74       23 -24  59     u=174  imp:n=1   $ clad
2917  174  -10.2144   -25  59       u=174  imp:n=1  vol=78.9937  $ fuel
2918  4  -1.785E-4   25 -26  59     u=174  imp:n=1   $ gap
2919  2  -6.74       26 -27  59     u=174  imp:n=1   $ clad
2920  174  -10.2144   -28  59       u=174  imp:n=1  vol=78.9937  $ fuel
2921  4  -1.785E-4   28 -29  59     u=174  imp:n=1   $ gap
2922  2  -6.74       29 -30  59     u=174  imp:n=1   $ clad
2923  174  -10.2144   -31  59       u=174  imp:n=1  vol=78.9937  $ fuel
```

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2924  4  -1.785E-4   31 -32  59     u=174  imp:n=1   $ gap
2925  2  -6.74       32 -33  59     u=174  imp:n=1   $ clad
2926  174  -10.2144   -34  59       u=174  imp:n=1  vol=78.9937  $ fuel
2927  4  -1.785E-4   34 -35  59     u=174  imp:n=1   $ gap
2928  2  -6.74       35 -36  59     u=174  imp:n=1   $ clad
2929  174  -10.2144   -37  59       u=174  imp:n=1  vol=78.9937  $ fuel
2930  4  -1.785E-4   37 -38  59     u=174  imp:n=1   $ gap
2931  2  -6.74       38 -39  59     u=174  imp:n=1   $ clad
2932  174  -10.2144   -40  59       u=174  imp:n=1  vol=78.9937  $ fuel
2933  4  -1.785E-4   40 -41  59     u=174  imp:n=1   $ gap
2934  2  -6.74       41 -42  59     u=174  imp:n=1   $ clad
2935  174  -10.2144   -43  59       u=174  imp:n=1  vol=78.9937  $ fuel
2936  4  -1.785E-4   43 -44  59     u=174  imp:n=1   $ gap
2937  2  -6.74       44 -45  59     u=174  imp:n=1   $ clad
2938  174  -10.2144   -46  59       u=174  imp:n=1  vol=78.9937  $ fuel
2939  4  -1.785E-4   46 -47  59     u=174  imp:n=1   $ gap
2940  2  -6.74       47 -48  59     u=174  imp:n=1   $ clad
2941  174  -10.2144   -49  59       u=174  imp:n=1  vol=78.9937  $ fuel
2942  4  -1.785E-4   49 -50  59     u=174  imp:n=1   $ gap
2943  2  -6.74       50 -51  59     u=174  imp:n=1   $ clad
2944  174  -10.2144   -52  59       u=174  imp:n=1  vol=78.9937  $ fuel
2945  4  -1.785E-4   52 -53  59     u=174  imp:n=1   $ gap
2946  2  -6.74       53 -54  59     u=174  imp:n=1   $ clad
2947  174  -10.2144   -55  59       u=174  imp:n=1  vol=78.9937  $ fuel
2948  4  -1.785E-4   55 -56  59     u=174  imp:n=1   $ gap
2949  2  -6.74       56 -57  59     u=174  imp:n=1   $ clad
2950  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=174  imp:n=1    $ D2O coolant
2951  3  -0.8143    -59 -60          u=174  imp:n=1    $ spacer
C      ********************************************************************
2952   181  -10.2144   -1  59        u=181  imp:n=1  vol=78.9937  $ fuel
2953   4  -1.785E-4   1 -2  59       u=181  imp:n=1   $ gap
2954   2  -6.74       2 -3  59       u=181  imp:n=1   $ clad
2955   181  -10.2144   -4  59       u=181  imp:n=1  vol=78.9937  $ fuel
2956   4  -1.785E-4   4 -5  59       u=181  imp:n=1   $ gap
2957   2  -6.74       5 -6  59       u=181  imp:n=1   $ clad
2958   181  -10.2144   -7  59       u=181  imp:n=1  vol=78.9937  $ fuel
2959   4  -1.785E-4   7 -8  59       u=181  imp:n=1   $ gap
2960   2  -6.74       8 -9  59       u=181  imp:n=1   $ clad
2961  181  -10.2144   -10   59      u=181  imp:n=1  vol=78.9937  $ fuel
2962  4  -1.785E-4   10 -11  59     u=181  imp:n=1   $ gap
2963  2  -6.74       11 -12  59     u=181  imp:n=1   $ clad
2964  181  -10.2144   -13  59       u=181  imp:n=1  vol=78.9937  $ fuel
2965  4  -1.785E-4   13 -14  59     u=181  imp:n=1   $ gap
2966  2  -6.74       14 -15  59     u=181  imp:n=1   $ clad
2967  181  -10.2144   -16  59       u=181  imp:n=1  vol=78.9937  $ fuel
2968  4  -1.785E-4   16 -17  59     u=181  imp:n=1   $ gap
2969  2  -6.74       17 -18  59     u=181  imp:n=1   $ clad
2970  181  -10.2144   -19  59       u=181  imp:n=1  vol=78.9937  $ fuel
2971  4  -1.785E-4   19 -20  59     u=181  imp:n=1   $ gap
2972  2  -6.74       20 -21  59     u=181  imp:n=1   $ clad
2973  181  -10.2144   -22  59       u=181  imp:n=1  vol=78.9937  $ fuel
2974  4  -1.785E-4   22 -23  59     u=181  imp:n=1   $ gap
2975  2  -6.74       23 -24  59     u=181  imp:n=1   $ clad
2976  181  -10.2144   -25  59       u=181  imp:n=1  vol=78.9937  $ fuel
```

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2977  4  -1.785E-4   25 -26  59     u=181  imp:n=1   $ gap
2978  2  -6.74       26 -27  59     u=181  imp:n=1   $ clad
2979  181  -10.2144   -28  59       u=181  imp:n=1  vol=78.9937  $ fuel
2980  4  -1.785E-4   28 -29  59     u=181  imp:n=1   $ gap
2981  2  -6.74       29 -30  59     u=181  imp:n=1   $ clad
2982  181  -10.2144   -31  59       u=181  imp:n=1  vol=78.9937  $ fuel
2983  4  -1.785E-4   31 -32  59     u=181  imp:n=1   $ gap
2984  2  -6.74       32 -33  59     u=181  imp:n=1   $ clad
2985  181  -10.2144   -34  59       u=181  imp:n=1  vol=78.9937  $ fuel
2986  4  -1.785E-4   34 -35  59     u=181  imp:n=1   $ gap
2987  2  -6.74       35 -36  59     u=181  imp:n=1   $ clad
2988  181  -10.2144   -37  59       u=181  imp:n=1  vol=78.9937  $ fuel
2989  4  -1.785E-4   37 -38  59     u=181  imp:n=1   $ gap
2990  2  -6.74       38 -39  59     u=181  imp:n=1   $ clad
2991  181  -10.2144   -40  59       u=181  imp:n=1  vol=78.9937  $ fuel
2992  4  -1.785E-4   40 -41  59     u=181  imp:n=1   $ gap
2993  2  -6.74       41 -42  59     u=181  imp:n=1   $ clad
2994  181  -10.2144   -43  59       u=181  imp:n=1  vol=78.9937  $ fuel
2995  4  -1.785E-4   43 -44  59     u=181  imp:n=1   $ gap
2996  2  -6.74       44 -45  59     u=181  imp:n=1   $ clad
2997  181  -10.2144   -46  59       u=181  imp:n=1  vol=78.9937  $ fuel
2998  4  -1.785E-4   46 -47  59     u=181  imp:n=1   $ gap
2999  2  -6.74       47 -48  59     u=181  imp:n=1   $ clad
3000  181  -10.2144   -49  59       u=181  imp:n=1  vol=78.9937  $ fuel
3001  4  -1.785E-4   49 -50  59     u=181  imp:n=1   $ gap
3002  2  -6.74       50 -51  59     u=181  imp:n=1   $ clad
3003  181  -10.2144   -52  59       u=181  imp:n=1  vol=78.9937  $ fuel
3004  4  -1.785E-4   52 -53  59     u=181  imp:n=1   $ gap
3005  2  -6.74       53 -54  59     u=181  imp:n=1   $ clad
3006  181  -10.2144   -55  59       u=181  imp:n=1  vol=78.9937  $ fuel
3007  4  -1.785E-4   55 -56  59     u=181  imp:n=1   $ gap
3008  2  -6.74       56 -57  59     u=181  imp:n=1   $ clad
3009  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=181  imp:n=1    $ D2O coolant
3010  3  -0.8143    -59 -60          u=181  imp:n=1    $ spacer
C      ************************************************************
3011   182  -10.2144   -1  59        u=182  imp:n=1  vol=78.9937  $ fuel
3012   4  -1.785E-4   1 -2  59       u=182  imp:n=1   $ gap
3013   2  -6.74       2 -3  59       u=182  imp:n=1   $ clad
3014   182  -10.2144   -4  59        u=182  imp:n=1  vol=78.9937  $ fuel
3015   4  -1.785E-4   4 -5  59       u=182  imp:n=1   $ gap
3016   2  -6.74       5 -6  59       u=182  imp:n=1   $ clad
3017   182  -10.2144   -7  59        u=182  imp:n=1  vol=78.9937  $ fuel
3018   4  -1.785E-4   7 -8  59       u=182  imp:n=1   $ gap
3019   2  -6.74       8 -9  59       u=182  imp:n=1   $ clad
3020  182  -10.2144   -10   59      u=182  imp:n=1  vol=78.9937  $ fuel
3021  4  -1.785E-4   10 -11  59     u=182  imp:n=1   $ gap
3022  2  -6.74       11 -12  59     u=182  imp:n=1   $ clad
3023  182  -10.2144   -13  59       u=182  imp:n=1  vol=78.9937  $ fuel
3024  4  -1.785E-4   13 -14  59     u=182  imp:n=1   $ gap
3025  2  -6.74       14 -15  59     u=182  imp:n=1   $ clad
3026  182  -10.2144   -16  59       u=182  imp:n=1  vol=78.9937  $ fuel
3027  4  -1.785E-4   16 -17  59     u=182  imp:n=1   $ gap
3028  2  -6.74       17 -18  59     u=182  imp:n=1   $ clad
3029  182  -10.2144   -19  59       u=182  imp:n=1  vol=78.9937  $ fuel
```

```
3030  4  -1.785E-4   19 -20  59     u=182  imp:n=1   $ gap
3031  2  -6.74       20 -21  59     u=182  imp:n=1   $ clad
3032  182  -10.2144   -22  59       u=182  imp:n=1  vol=78.9937  $ fuel
3033  4  -1.785E-4   22 -23  59     u=182  imp:n=1   $ gap
3034  2  -6.74       23 -24  59     u=182  imp:n=1   $ clad
3035  182  -10.2144   -25  59       u=182  imp:n=1  vol=78.9937  $ fuel
3036  4  -1.785E-4   25 -26  59     u=182  imp:n=1   $ gap
3037  2  -6.74       26 -27  59     u=182  imp:n=1   $ clad
3038  182  -10.2144   -28  59       u=182  imp:n=1  vol=78.9937  $ fuel
3039  4  -1.785E-4   28 -29  59     u=182  imp:n=1   $ gap
3040  2  -6.74       29 -30  59     u=182  imp:n=1   $ clad
3041  182  -10.2144   -31  59       u=182  imp:n=1  vol=78.9937  $ fuel
3042  4  -1.785E-4   31 -32  59     u=182  imp:n=1   $ gap
3043  2  -6.74       32 -33  59     u=182  imp:n=1   $ clad
3044  182  -10.2144   -34  59       u=182  imp:n=1  vol=78.9937  $ fuel
3045  4  -1.785E-4   34 -35  59     u=182  imp:n=1   $ gap
3046  2  -6.74       35 -36  59     u=182  imp:n=1   $ clad
3047  182  -10.2144   -37  59       u=182  imp:n=1  vol=78.9937  $ fuel
3048  4  -1.785E-4   37 -38  59     u=182  imp:n=1   $ gap
3049  2  -6.74       38 -39  59     u=182  imp:n=1   $ clad
3050  182  -10.2144   -40  59       u=182  imp:n=1  vol=78.9937  $ fuel
3051  4  -1.785E-4   40 -41  59     u=182  imp:n=1   $ gap
3052  2  -6.74       41 -42  59     u=182  imp:n=1   $ clad
3053  182  -10.2144   -43  59       u=182  imp:n=1  vol=78.9937  $ fuel
3054  4  -1.785E-4   43 -44  59     u=182  imp:n=1   $ gap
3055  2  -6.74       44 -45  59     u=182  imp:n=1   $ clad
3056  182  -10.2144   -46  59       u=182  imp:n=1  vol=78.9937  $ fuel
3057  4  -1.785E-4   46 -47  59     u=182  imp:n=1   $ gap
3058  2  -6.74       47 -48  59     u=182  imp:n=1   $ clad
3059  182  -10.2144   -49  59       u=182  imp:n=1  vol=78.9937  $ fuel
3060  4  -1.785E-4   49 -50  59     u=182  imp:n=1   $ gap
3061  2  -6.74       50 -51  59     u=182  imp:n=1   $ clad
3062  182  -10.2144   -52  59       u=182  imp:n=1  vol=78.9937  $ fuel
3063  4  -1.785E-4   52 -53  59     u=182  imp:n=1   $ gap
3064  2  -6.74       53 -54  59     u=182  imp:n=1   $ clad
3065  182  -10.2144   -55  59       u=182  imp:n=1  vol=78.9937  $ fuel
3066  4  -1.785E-4   55 -56  59     u=182  imp:n=1   $ gap
3067  2  -6.74       56 -57  59     u=182  imp:n=1   $ clad
3068  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=182  imp:n=1    $ D2O coolant
3069  3  -0.8143    -59 -60          u=182  imp:n=1    $ spacer
C      ***************************************************************
3070   184  -10.2144   -1  59        u=184  imp:n=1  vol=78.9937  $ fuel
3071   4  -1.785E-4   1 -2  59       u=184  imp:n=1   $ gap
3072   2  -6.74       2 -3  59       u=184  imp:n=1   $ clad
3073   184  -10.2144   -4  59        u=184  imp:n=1  vol=78.9937  $ fuel
3074   4  -1.785E-4   4 -5  59       u=184  imp:n=1   $ gap
3075   2  -6.74       5 -6  59       u=184  imp:n=1   $ clad
3076   184  -10.2144   -7  59        u=184  imp:n=1  vol=78.9937  $ fuel
3077   4  -1.785E-4   7 -8  59       u=184  imp:n=1   $ gap
3078   2  -6.74       8 -9  59       u=184  imp:n=1   $ clad
3079  184  -10.2144   -10   59      u=184  imp:n=1  vol=78.9937  $ fuel
3080  4  -1.785E-4   10 -11  59     u=184  imp:n=1   $ gap
3081  2  -6.74       11 -12  59     u=184  imp:n=1   $ clad
3082  184  -10.2144   -13  59       u=184  imp:n=1  vol=78.9937  $ fuel
```

```
3083  4  -1.785E-4   13 -14  59     u=184  imp:n=1   $ gap
3084  2  -6.74       14 -15  59     u=184  imp:n=1   $ clad
3085  184  -10.2144   -16  59       u=184  imp:n=1  vol=78.9937  $ fuel
3086  4  -1.785E-4   16 -17  59     u=184  imp:n=1   $ gap
3087  2  -6.74       17 -18  59     u=184  imp:n=1   $ clad
3088  184  -10.2144   -19  59       u=184  imp:n=1  vol=78.9937  $ fuel
3089  4  -1.785E-4   19 -20  59     u=184  imp:n=1   $ gap
3090  2  -6.74       20 -21  59     u=184  imp:n=1   $ clad
3091  184  -10.2144   -22  59       u=184  imp:n=1  vol=78.9937  $ fuel
3092  4  -1.785E-4   22 -23  59     u=184  imp:n=1   $ gap
3093  2  -6.74       23 -24  59     u=184  imp:n=1   $ clad
3094  184  -10.2144   -25  59       u=184  imp:n=1  vol=78.9937  $ fuel
3095  4  -1.785E-4   25 -26  59     u=184  imp:n=1   $ gap
3096  2  -6.74       26 -27  59     u=184  imp:n=1   $ clad
3097  184  -10.2144   -28  59       u=184  imp:n=1  vol=78.9937  $ fuel
3098  4  -1.785E-4   28 -29  59     u=184  imp:n=1   $ gap
3099  2  -6.74       29 -30  59     u=184  imp:n=1   $ clad
3100  184  -10.2144   -31  59       u=184  imp:n=1  vol=78.9937  $ fuel
3101  4  -1.785E-4   31 -32  59     u=184  imp:n=1   $ gap
3102  2  -6.74       32 -33  59     u=184  imp:n=1   $ clad
3103  184  -10.2144   -34  59       u=184  imp:n=1  vol=78.9937  $ fuel
3104  4  -1.785E-4   34 -35  59     u=184  imp:n=1   $ gap
3105  2  -6.74       35 -36  59     u=184  imp:n=1   $ clad
3106  184  -10.2144   -37  59       u=184  imp:n=1  vol=78.9937  $ fuel
3107  4  -1.785E-4   37 -38  59     u=184  imp:n=1   $ gap
3108  2  -6.74       38 -39  59     u=184  imp:n=1   $ clad
3109  184  -10.2144   -40  59       u=184  imp:n=1  vol=78.9937  $ fuel
3110  4  -1.785E-4   40 -41  59     u=184  imp:n=1   $ gap
3111  2  -6.74       41 -42  59     u=184  imp:n=1   $ clad
3112  184  -10.2144   -43  59       u=184  imp:n=1  vol=78.9937  $ fuel
3113  4  -1.785E-4   43 -44  59     u=184  imp:n=1   $ gap
3114  2  -6.74       44 -45  59     u=184  imp:n=1   $ clad
3115  184  -10.2144   -46  59       u=184  imp:n=1  vol=78.9937  $ fuel
3116  4  -1.785E-4   46 -47  59     u=184  imp:n=1   $ gap
3117  2  -6.74       47 -48  59     u=184  imp:n=1   $ clad
3118  184  -10.2144   -49  59       u=184  imp:n=1  vol=78.9937  $ fuel
3119  4  -1.785E-4   49 -50  59     u=184  imp:n=1   $ gap
3120  2  -6.74       50 -51  59     u=184  imp:n=1   $ clad
3121  184  -10.2144   -52  59       u=184  imp:n=1  vol=78.9937  $ fuel
3122  4  -1.785E-4   52 -53  59     u=184  imp:n=1   $ gap
3123  2  -6.74       53 -54  59     u=184  imp:n=1   $ clad
3124  184  -10.2144   -55  59       u=184  imp:n=1  vol=78.9937  $ fuel
3125  4  -1.785E-4   55 -56  59     u=184  imp:n=1   $ gap
3126  2  -6.74       56 -57  59     u=184  imp:n=1   $ clad
3127  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=184  imp:n=1    $ D2O coolant
3128  3  -0.8143    -59 -60          u=184  imp:n=1    $ spacer
C      ************************************************************
3129   191  -10.2144   -1  59        u=191  imp:n=1  vol=78.9937  $ fuel
3130   4  -1.785E-4   1 -2  59       u=191  imp:n=1   $ gap
3131   2  -6.74       2 -3  59       u=191  imp:n=1   $ clad
3132   191  -10.2144   -4  59       u=191  imp:n=1  vol=78.9937  $ fuel
3133   4  -1.785E-4   4 -5  59       u=191  imp:n=1   $ gap
3134   2  -6.74       5 -6  59       u=191  imp:n=1   $ clad
3135   191  -10.2144   -7  59       u=191  imp:n=1  vol=78.9937  $ fuel
```

```
3136   4  -1.785E-4   7 -8  59       u=191  imp:n=1   $ gap
3137   2  -6.74       8 -9  59       u=191  imp:n=1   $ clad
3138  191  -10.2144   -10   59      u=191  imp:n=1  vol=78.9937  $ fuel
3139  4  -1.785E-4   10 -11  59     u=191  imp:n=1   $ gap
3140  2  -6.74       11 -12  59     u=191  imp:n=1   $ clad
3141  191  -10.2144   -13  59       u=191  imp:n=1  vol=78.9937  $ fuel
3142  4  -1.785E-4   13 -14  59     u=191  imp:n=1   $ gap
3143  2  -6.74       14 -15  59     u=191  imp:n=1   $ clad
3144  191  -10.2144   -16  59       u=191  imp:n=1  vol=78.9937  $ fuel
3145  4  -1.785E-4   16 -17  59     u=191  imp:n=1   $ gap
3146  2  -6.74       17 -18  59     u=191  imp:n=1   $ clad
3147  191  -10.2144   -19  59       u=191  imp:n=1  vol=78.9937  $ fuel
3148  4  -1.785E-4   19 -20  59     u=191  imp:n=1   $ gap
3149  2  -6.74       20 -21  59     u=191  imp:n=1   $ clad
3150  191  -10.2144   -22  59       u=191  imp:n=1  vol=78.9937  $ fuel
3151  4  -1.785E-4   22 -23  59     u=191  imp:n=1   $ gap
3152  2  -6.74       23 -24  59     u=191  imp:n=1   $ clad
3153  191  -10.2144   -25  59       u=191  imp:n=1  vol=78.9937  $ fuel
3154  4  -1.785E-4   25 -26  59     u=191  imp:n=1   $ gap
3155  2  -6.74       26 -27  59     u=191  imp:n=1   $ clad
3156  191  -10.2144   -28  59       u=191  imp:n=1  vol=78.9937  $ fuel
3157  4  -1.785E-4   28 -29  59     u=191  imp:n=1   $ gap
3158  2  -6.74       29 -30  59     u=191  imp:n=1   $ clad
3159  191  -10.2144   -31  59       u=191  imp:n=1  vol=78.9937  $ fuel
3160  4  -1.785E-4   31 -32  59     u=191  imp:n=1   $ gap
3161  2  -6.74       32 -33  59     u=191  imp:n=1   $ clad
3162  191  -10.2144   -34  59       u=191  imp:n=1  vol=78.9937  $ fuel
3163  4  -1.785E-4   34 -35  59     u=191  imp:n=1   $ gap
3164  2  -6.74       35 -36  59     u=191  imp:n=1   $ clad
3165  191  -10.2144   -37  59       u=191  imp:n=1  vol=78.9937  $ fuel
3166  4  -1.785E-4   37 -38  59     u=191  imp:n=1   $ gap
3167  2  -6.74       38 -39  59     u=191  imp:n=1   $ clad
3168  191  -10.2144   -40  59       u=191  imp:n=1  vol=78.9937  $ fuel
3169  4  -1.785E-4   40 -41  59     u=191  imp:n=1   $ gap
3170  2  -6.74       41 -42  59     u=191  imp:n=1   $ clad
3171  191  -10.2144   -43  59       u=191  imp:n=1  vol=78.9937  $ fuel
3172  4  -1.785E-4   43 -44  59     u=191  imp:n=1   $ gap
3173  2  -6.74       44 -45  59     u=191  imp:n=1   $ clad
3174  191  -10.2144   -46  59       u=191  imp:n=1  vol=78.9937  $ fuel
3175  4  -1.785E-4   46 -47  59     u=191  imp:n=1   $ gap
3176  2  -6.74       47 -48  59     u=191  imp:n=1   $ clad
3177  191  -10.2144   -49  59       u=191  imp:n=1  vol=78.9937  $ fuel
3178  4  -1.785E-4   49 -50  59     u=191  imp:n=1   $ gap
3179  2  -6.74       50 -51  59     u=191  imp:n=1   $ clad
3180  191  -10.2144   -52  59       u=191  imp:n=1  vol=78.9937  $ fuel
3181  4  -1.785E-4   52 -53  59     u=191  imp:n=1   $ gap
3182  2  -6.74       53 -54  59     u=191  imp:n=1   $ clad
3183  191  -10.2144   -55  59       u=191  imp:n=1  vol=78.9937  $ fuel
3184  4  -1.785E-4   55 -56  59     u=191  imp:n=1   $ gap
3185  2  -6.74       56 -57  59     u=191  imp:n=1   $ clad
3186  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)      u=191  imp:n=1    $ D2O coolant
3187  3  -0.8143    -59 -60          u=191  imp:n=1    $ spacer
C      ************************************************************
3188   192  -10.2144   -1  59        u=192  imp:n=1  vol=78.9937  $ fuel
```

```
3189   4  -1.785E-4   1 -2  59       u=192  imp:n=1   $ gap
3190   2  -6.74       2 -3  59       u=192  imp:n=1   $ clad
3191   192  -10.2144   -4  59       u=192  imp:n=1  vol=78.9937  $ fuel
3192   4  -1.785E-4   4 -5  59       u=192  imp:n=1   $ gap
3193   2  -6.74       5 -6  59       u=192  imp:n=1   $ clad
3194   192  -10.2144   -7  59       u=192  imp:n=1  vol=78.9937  $ fuel
3195   4  -1.785E-4   7 -8  59       u=192  imp:n=1   $ gap
3196   2  -6.74       8 -9  59       u=192  imp:n=1   $ clad
3197  192  -10.2144   -10   59      u=192  imp:n=1  vol=78.9937  $ fuel
3198  4  -1.785E-4   10 -11  59     u=192  imp:n=1   $ gap
3199  2  -6.74       11 -12  59     u=192  imp:n=1   $ clad
3200  192  -10.2144   -13  59       u=192  imp:n=1  vol=78.9937  $ fuel
3201  4  -1.785E-4   13 -14  59     u=192  imp:n=1   $ gap
3202  2  -6.74       14 -15  59     u=192  imp:n=1   $ clad
3203  192  -10.2144   -16  59       u=192  imp:n=1  vol=78.9937  $ fuel
3204  4  -1.785E-4   16 -17  59     u=192  imp:n=1   $ gap
3205  2  -6.74       17 -18  59     u=192  imp:n=1   $ clad
3206  192  -10.2144   -19  59       u=192  imp:n=1  vol=78.9937  $ fuel
3207  4  -1.785E-4   19 -20  59     u=192  imp:n=1   $ gap
3208  2  -6.74       20 -21  59     u=192  imp:n=1   $ clad
3209  192  -10.2144   -22  59       u=192  imp:n=1  vol=78.9937  $ fuel
3210  4  -1.785E-4   22 -23  59     u=192  imp:n=1   $ gap
3211  2  -6.74       23 -24  59     u=192  imp:n=1   $ clad
3212  192  -10.2144   -25  59       u=192  imp:n=1  vol=78.9937  $ fuel
3213  4  -1.785E-4   25 -26  59     u=192  imp:n=1   $ gap
3214  2  -6.74       26 -27  59     u=192  imp:n=1   $ clad
3215  192  -10.2144   -28  59       u=192  imp:n=1  vol=78.9937  $ fuel
3216  4  -1.785E-4   28 -29  59     u=192  imp:n=1   $ gap
3217  2  -6.74       29 -30  59     u=192  imp:n=1   $ clad
3218  192  -10.2144   -31  59       u=192  imp:n=1  vol=78.9937  $ fuel
3219  4  -1.785E-4   31 -32  59     u=192  imp:n=1   $ gap
3220  2  -6.74       32 -33  59     u=192  imp:n=1   $ clad
3221  192  -10.2144   -34  59       u=192  imp:n=1  vol=78.9937  $ fuel
3222  4  -1.785E-4   34 -35  59     u=192  imp:n=1   $ gap
3223  2  -6.74       35 -36  59     u=192  imp:n=1   $ clad
3224  192  -10.2144   -37  59       u=192  imp:n=1  vol=78.9937  $ fuel
3225  4  -1.785E-4   37 -38  59     u=192  imp:n=1   $ gap
3226  2  -6.74       38 -39  59     u=192  imp:n=1   $ clad
3227  192  -10.2144   -40  59       u=192  imp:n=1  vol=78.9937  $ fuel
3228  4  -1.785E-4   40 -41  59     u=192  imp:n=1   $ gap
3229  2  -6.74       41 -42  59     u=192  imp:n=1   $ clad
3230  192  -10.2144   -43  59       u=192  imp:n=1  vol=78.9937  $ fuel
3231  4  -1.785E-4   43 -44  59     u=192  imp:n=1   $ gap
3232  2  -6.74       44 -45  59     u=192  imp:n=1   $ clad
3233  192  -10.2144   -46  59       u=192  imp:n=1  vol=78.9937  $ fuel
3234  4  -1.785E-4   46 -47  59     u=192  imp:n=1   $ gap
3235  2  -6.74       47 -48  59     u=192  imp:n=1   $ clad
3236  192  -10.2144   -49  59       u=192  imp:n=1  vol=78.9937  $ fuel
3237  4  -1.785E-4   49 -50  59     u=192  imp:n=1   $ gap
3238  2  -6.74       50 -51  59     u=192  imp:n=1   $ clad
3239  192  -10.2144   -52  59       u=192  imp:n=1  vol=78.9937  $ fuel
3240  4  -1.785E-4   52 -53  59     u=192  imp:n=1   $ gap
3241  2  -6.74       53 -54  59     u=192  imp:n=1   $ clad
3242  192  -10.2144   -55  59       u=192  imp:n=1  vol=78.9937  $ fuel
3243  4  -1.785E-4   55 -56  59     u=192  imp:n=1   $ gap
```

```
3244  2  -6.74       56 -57  59     u=192  imp:n=1   $ clad
3245  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=192  imp:n=1    $ D2O coolant
3246  3  -0.8143    -59 -60          u=192  imp:n=1    $ spacer
C      ************************************************************
3247   194  -10.2144   -1  59        u=194  imp:n=1  vol=78.9937  $ fuel
3248   4  -1.785E-4   1 -2  59       u=194  imp:n=1   $ gap
3249   2  -6.74       2 -3  59       u=194  imp:n=1   $ clad
3250   194  -10.2144   -4  59        u=194  imp:n=1  vol=78.9937  $ fuel
3251   4  -1.785E-4   4 -5  59       u=194  imp:n=1   $ gap
3252   2  -6.74       5 -6  59       u=194  imp:n=1   $ clad
3253   194  -10.2144   -7  59        u=194  imp:n=1  vol=78.9937  $ fuel
3254   4  -1.785E-4   7 -8  59       u=194  imp:n=1   $ gap
3255   2  -6.74       8 -9  59       u=194  imp:n=1   $ clad
3256  194  -10.2144   -10   59      u=194  imp:n=1  vol=78.9937  $ fuel
3257  4  -1.785E-4   10 -11  59     u=194  imp:n=1   $ gap
3258  2  -6.74       11 -12  59     u=194  imp:n=1   $ clad
3259  194  -10.2144   -13  59       u=194  imp:n=1  vol=78.9937  $ fuel
3260  4  -1.785E-4   13 -14  59     u=194  imp:n=1   $ gap
3261  2  -6.74       14 -15  59     u=194  imp:n=1   $ clad
3262  194  -10.2144   -16  59       u=194  imp:n=1  vol=78.9937  $ fuel
3263  4  -1.785E-4   16 -17  59     u=194  imp:n=1   $ gap
3264  2  -6.74       17 -18  59     u=194  imp:n=1   $ clad
3265  194  -10.2144   -19  59       u=194  imp:n=1  vol=78.9937  $ fuel
3266  4  -1.785E-4   19 -20  59     u=194  imp:n=1   $ gap
3267  2  -6.74       20 -21  59     u=194  imp:n=1   $ clad
3268  194  -10.2144   -22  59       u=194  imp:n=1  vol=78.9937  $ fuel
3269  4  -1.785E-4   22 -23  59     u=194  imp:n=1   $ gap
3270  2  -6.74       23 -24  59     u=194  imp:n=1   $ clad
3271  194  -10.2144   -25  59       u=194  imp:n=1  vol=78.9937  $ fuel
3272  4  -1.785E-4   25 -26  59     u=194  imp:n=1   $ gap
3273  2  -6.74       26 -27  59     u=194  imp:n=1   $ clad
3274  194  -10.2144   -28  59       u=194  imp:n=1  vol=78.9937  $ fuel
3275  4  -1.785E-4   28 -29  59     u=194  imp:n=1   $ gap
3276  2  -6.74       29 -30  59     u=194  imp:n=1   $ clad
3277  194  -10.2144   -31  59       u=194  imp:n=1  vol=78.9937  $ fuel
3278  4  -1.785E-4   31 -32  59     u=194  imp:n=1   $ gap
3279  2  -6.74       32 -33  59     u=194  imp:n=1   $ clad
3280  194  -10.2144   -34  59       u=194  imp:n=1  vol=78.9937  $ fuel
3281  4  -1.785E-4   34 -35  59     u=194  imp:n=1   $ gap
3282  2  -6.74       35 -36  59     u=194  imp:n=1   $ clad
3283  194  -10.2144   -37  59       u=194  imp:n=1  vol=78.9937  $ fuel
3284  4  -1.785E-4   37 -38  59     u=194  imp:n=1   $ gap
3285  2  -6.74       38 -39  59     u=194  imp:n=1   $ clad
3286  194  -10.2144   -40  59       u=194  imp:n=1  vol=78.9937  $ fuel
3287  4  -1.785E-4   40 -41  59     u=194  imp:n=1   $ gap
3288  2  -6.74       41 -42  59     u=194  imp:n=1   $ clad
3289  194  -10.2144   -43  59       u=194  imp:n=1  vol=78.9937  $ fuel
3290  4  -1.785E-4   43 -44  59     u=194  imp:n=1   $ gap
3291  2  -6.74       44 -45  59     u=194  imp:n=1   $ clad
3292  194  -10.2144   -46  59       u=194  imp:n=1  vol=78.9937  $ fuel
3293  4  -1.785E-4   46 -47  59     u=194  imp:n=1   $ gap
3294  2  -6.74       47 -48  59     u=194  imp:n=1   $ clad
3295  194  -10.2144   -49  59       u=194  imp:n=1  vol=78.9937  $ fuel
3296  4  -1.785E-4   49 -50  59     u=194  imp:n=1   $ gap
```

```
3297  2  -6.74       50 -51  59     u=194  imp:n=1   $ clad
3298  194  -10.2144   -52  59       u=194  imp:n=1  vol=78.9937  $ fuel
3299  4  -1.785E-4   52 -53  59     u=194  imp:n=1   $ gap
3300  2  -6.74       53 -54  59     u=194  imp:n=1   $ clad
3301  194  -10.2144   -55  59       u=194  imp:n=1  vol=78.9937  $ fuel
3302  4  -1.785E-4   55 -56  59     u=194  imp:n=1   $ gap
3303  2  -6.74       56 -57  59     u=194  imp:n=1   $ clad
3304  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=194  imp:n=1    $ D2O coolant
3305  3  -0.8143    -59 -60          u=194  imp:n=1    $ spacer
C      ********************************************************************
3306   201  -10.2144   -1  59        u=201  imp:n=1  vol=78.9937  $ fuel
3307   4  -1.785E-4   1 -2  59       u=201  imp:n=1   $ gap
3308   2  -6.74       2 -3  59       u=201  imp:n=1   $ clad
3309   201  -10.2144   -4  59        u=201  imp:n=1  vol=78.9937  $ fuel
3310   4  -1.785E-4   4 -5  59       u=201  imp:n=1   $ gap
3311   2  -6.74       5 -6  59       u=201  imp:n=1   $ clad
3312   201  -10.2144   -7  59        u=201  imp:n=1  vol=78.9937  $ fuel
3313   4  -1.785E-4   7 -8  59       u=201  imp:n=1   $ gap
3314   2  -6.74       8 -9  59       u=201  imp:n=1   $ clad
3315  201  -10.2144   -10   59      u=201  imp:n=1  vol=78.9937  $ fuel
3316  4  -1.785E-4   10 -11  59     u=201  imp:n=1   $ gap
3317  2  -6.74       11 -12  59     u=201  imp:n=1   $ clad
3318  201  -10.2144   -13  59       u=201  imp:n=1  vol=78.9937  $ fuel
3319  4  -1.785E-4   13 -14  59     u=201  imp:n=1   $ gap
3320  2  -6.74       14 -15  59     u=201  imp:n=1   $ clad
3321  201  -10.2144   -16  59       u=201  imp:n=1  vol=78.9937  $ fuel
3322  4  -1.785E-4   16 -17  59     u=201  imp:n=1   $ gap
3323  2  -6.74       17 -18  59     u=201  imp:n=1   $ clad
3324  201  -10.2144   -19  59       u=201  imp:n=1  vol=78.9937  $ fuel
3325  4  -1.785E-4   19 -20  59     u=201  imp:n=1   $ gap
3326  2  -6.74       20 -21  59     u=201  imp:n=1   $ clad
3327  201  -10.2144   -22  59       u=201  imp:n=1  vol=78.9937  $ fuel
3328  4  -1.785E-4   22 -23  59     u=201  imp:n=1   $ gap
3329  2  -6.74       23 -24  59     u=201  imp:n=1   $ clad
3330  201  -10.2144   -25  59       u=201  imp:n=1  vol=78.9937  $ fuel
3331  4  -1.785E-4   25 -26  59     u=201  imp:n=1   $ gap
3332  2  -6.74       26 -27  59     u=201  imp:n=1   $ clad
3333  201  -10.2144   -28  59       u=201  imp:n=1  vol=78.9937  $ fuel
3334  4  -1.785E-4   28 -29  59     u=201  imp:n=1   $ gap
3335  2  -6.74       29 -30  59     u=201  imp:n=1   $ clad
3336  201  -10.2144   -31  59       u=201  imp:n=1  vol=78.9937  $ fuel
3337  4  -1.785E-4   31 -32  59     u=201  imp:n=1   $ gap
3338  2  -6.74       32 -33  59     u=201  imp:n=1   $ clad
3339  201  -10.2144   -34  59       u=201  imp:n=1  vol=78.9937  $ fuel
3340  4  -1.785E-4   34 -35  59     u=201  imp:n=1   $ gap
3341  2  -6.74       35 -36  59     u=201  imp:n=1   $ clad
3342  201  -10.2144   -37  59       u=201  imp:n=1  vol=78.9937  $ fuel
3343  4  -1.785E-4   37 -38  59     u=201  imp:n=1   $ gap
3344  2  -6.74       38 -39  59     u=201  imp:n=1   $ clad
3345  201  -10.2144   -40  59       u=201  imp:n=1  vol=78.9937  $ fuel
3346  4  -1.785E-4   40 -41  59     u=201  imp:n=1   $ gap
3347  2  -6.74       41 -42  59     u=201  imp:n=1   $ clad
3348  201  -10.2144   -43  59       u=201  imp:n=1  vol=78.9937  $ fuel
3349  4  -1.785E-4   43 -44  59     u=201  imp:n=1   $ gap
```

```
3350  2  -6.74       44 -45  59     u=201  imp:n=1   $ clad
3351  201  -10.2144   -46  59       u=201  imp:n=1  vol=78.9937  $ fuel
3352  4  -1.785E-4   46 -47  59     u=201  imp:n=1   $ gap
3353  2  -6.74       47 -48  59     u=201  imp:n=1   $ clad
3354  201  -10.2144   -49  59       u=201  imp:n=1  vol=78.9937  $ fuel
3355  4  -1.785E-4   49 -50  59     u=201  imp:n=1   $ gap
3356  2  -6.74       50 -51  59     u=201  imp:n=1   $ clad
3357  201  -10.2144   -52  59       u=201  imp:n=1  vol=78.9937  $ fuel
3358  4  -1.785E-4   52 -53  59     u=201  imp:n=1   $ gap
3359  2  -6.74       53 -54  59     u=201  imp:n=1   $ clad
3360  201  -10.2144   -55  59       u=201  imp:n=1  vol=78.9937  $ fuel
3361  4  -1.785E-4   55 -56  59     u=201  imp:n=1   $ gap
3362  2  -6.74       56 -57  59     u=201  imp:n=1   $ clad
3363  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=201  imp:n=1    $ D2O coolant
3364  3  -0.8143    -59 -60          u=201  imp:n=1    $ spacer
C      ************************************************************
3365   202  -10.2144   -1  59        u=202  imp:n=1  vol=78.9937  $ fuel
3366   4  -1.785E-4   1 -2  59       u=202  imp:n=1   $ gap
3367   2  -6.74       2 -3  59       u=202  imp:n=1   $ clad
3368   202  -10.2144   -4  59        u=202  imp:n=1  vol=78.9937  $ fuel
3369   4  -1.785E-4   4 -5  59       u=202  imp:n=1   $ gap
3370   2  -6.74       5 -6  59       u=202  imp:n=1   $ clad
3371   202  -10.2144   -7  59        u=202  imp:n=1  vol=78.9937  $ fuel
3372   4  -1.785E-4   7 -8  59       u=202  imp:n=1   $ gap
3373   2  -6.74       8 -9  59       u=202  imp:n=1   $ clad
3374  202  -10.2144   -10   59      u=202  imp:n=1  vol=78.9937  $ fuel
3375  4  -1.785E-4   10 -11  59     u=202  imp:n=1   $ gap
3376  2  -6.74       11 -12  59     u=202  imp:n=1   $ clad
3377  202  -10.2144   -13  59       u=202  imp:n=1  vol=78.9937  $ fuel
3378  4  -1.785E-4   13 -14  59     u=202  imp:n=1   $ gap
3379  2  -6.74       14 -15  59     u=202  imp:n=1   $ clad
3380  202  -10.2144   -16  59       u=202  imp:n=1  vol=78.9937  $ fuel
3381  4  -1.785E-4   16 -17  59     u=202  imp:n=1   $ gap
3382  2  -6.74       17 -18  59     u=202  imp:n=1   $ clad
3383  202  -10.2144   -19  59       u=202  imp:n=1  vol=78.9937  $ fuel
3384  4  -1.785E-4   19 -20  59     u=202  imp:n=1   $ gap
3385  2  -6.74       20 -21  59     u=202  imp:n=1   $ clad
3386  202  -10.2144   -22  59       u=202  imp:n=1  vol=78.9937  $ fuel
3387  4  -1.785E-4   22 -23  59     u=202  imp:n=1   $ gap
3388  2  -6.74       23 -24  59     u=202  imp:n=1   $ clad
3389  202  -10.2144   -25  59       u=202  imp:n=1  vol=78.9937  $ fuel
3390  4  -1.785E-4   25 -26  59     u=202  imp:n=1   $ gap
3391  2  -6.74       26 -27  59     u=202  imp:n=1   $ clad
3392  202  -10.2144   -28  59       u=202  imp:n=1  vol=78.9937  $ fuel
3393  4  -1.785E-4   28 -29  59     u=202  imp:n=1   $ gap
3394  2  -6.74       29 -30  59     u=202  imp:n=1   $ clad
3395  202  -10.2144   -31  59       u=202  imp:n=1  vol=78.9937  $ fuel
3396  4  -1.785E-4   31 -32  59     u=202  imp:n=1   $ gap
3397  2  -6.74       32 -33  59     u=202  imp:n=1   $ clad
3398  202  -10.2144   -34  59       u=202  imp:n=1  vol=78.9937  $ fuel
3399  4  -1.785E-4   34 -35  59     u=202  imp:n=1   $ gap
3400  2  -6.74       35 -36  59     u=202  imp:n=1   $ clad
3401  202  -10.2144   -37  59       u=202  imp:n=1  vol=78.9937  $ fuel
3402  4  -1.785E-4   37 -38  59     u=202  imp:n=1   $ gap
```

```
3403  2  -6.74       38 -39  59     u=202  imp:n=1   $ clad
3404  202  -10.2144   -40  59       u=202  imp:n=1  vol=78.9937  $ fuel
3405  4  -1.785E-4   40 -41  59     u=202  imp:n=1   $ gap
3406  2  -6.74       41 -42  59     u=202  imp:n=1   $ clad
3407  202  -10.2144   -43  59       u=202  imp:n=1  vol=78.9937  $ fuel
3408  4  -1.785E-4   43 -44  59     u=202  imp:n=1   $ gap
3409  2  -6.74       44 -45  59     u=202  imp:n=1   $ clad
3410  202  -10.2144   -46  59       u=202  imp:n=1  vol=78.9937  $ fuel
3411  4  -1.785E-4   46 -47  59     u=202  imp:n=1   $ gap
3412  2  -6.74       47 -48  59     u=202  imp:n=1   $ clad
3413  202  -10.2144   -49  59       u=202  imp:n=1  vol=78.9937  $ fuel
3414  4  -1.785E-4   49 -50  59     u=202  imp:n=1   $ gap
3415  2  -6.74       50 -51  59     u=202  imp:n=1   $ clad
3416  202  -10.2144   -52  59       u=202  imp:n=1  vol=78.9937  $ fuel
3417  4  -1.785E-4   52 -53  59     u=202  imp:n=1   $ gap
3418  2  -6.74       53 -54  59     u=202  imp:n=1   $ clad
3419  202  -10.2144   -55  59       u=202  imp:n=1  vol=78.9937  $ fuel
3420  4  -1.785E-4   55 -56  59     u=202  imp:n=1   $ gap
3421  2  -6.74       56 -57  59     u=202  imp:n=1   $ clad
3422  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=202  imp:n=1    $ D2O coolant
3423  3  -0.8143    -59 -60          u=202  imp:n=1    $ spacer
C      ************************************************************
3424   204  -10.2144   -1  59        u=204  imp:n=1  vol=78.9937  $ fuel
3425   4  -1.785E-4   1 -2  59       u=204  imp:n=1   $ gap
3426   2  -6.74       2 -3  59       u=204  imp:n=1   $ clad
3427   204  -10.2144   -4  59        u=204  imp:n=1  vol=78.9937  $ fuel
3428   4  -1.785E-4   4 -5  59       u=204  imp:n=1   $ gap
3429   2  -6.74       5 -6  59       u=204  imp:n=1   $ clad
3430   204  -10.2144   -7  59        u=204  imp:n=1  vol=78.9937  $ fuel
3431   4  -1.785E-4   7 -8  59       u=204  imp:n=1   $ gap
3432   2  -6.74       8 -9  59       u=204  imp:n=1   $ clad
3433  204  -10.2144   -10   59      u=204  imp:n=1  vol=78.9937  $ fuel
3434  4  -1.785E-4   10 -11  59     u=204  imp:n=1   $ gap
3435  2  -6.74       11 -12  59     u=204  imp:n=1   $ clad
3436  204  -10.2144   -13  59       u=204  imp:n=1  vol=78.9937  $ fuel
3437  4  -1.785E-4   13 -14  59     u=204  imp:n=1   $ gap
3438  2  -6.74       14 -15  59     u=204  imp:n=1   $ clad
3439  204  -10.2144   -16  59       u=204  imp:n=1  vol=78.9937  $ fuel
3440  4  -1.785E-4   16 -17  59     u=204  imp:n=1   $ gap
3441  2  -6.74       17 -18  59     u=204  imp:n=1   $ clad
3442  204  -10.2144   -19  59       u=204  imp:n=1  vol=78.9937  $ fuel
3443  4  -1.785E-4   19 -20  59     u=204  imp:n=1   $ gap
3444  2  -6.74       20 -21  59     u=204  imp:n=1   $ clad
3445  204  -10.2144   -22  59       u=204  imp:n=1  vol=78.9937  $ fuel
3446  4  -1.785E-4   22 -23  59     u=204  imp:n=1   $ gap
3447  2  -6.74       23 -24  59     u=204  imp:n=1   $ clad
3448  204  -10.2144   -25  59       u=204  imp:n=1  vol=78.9937  $ fuel
3449  4  -1.785E-4   25 -26  59     u=204  imp:n=1   $ gap
3450  2  -6.74       26 -27  59     u=204  imp:n=1   $ clad
3451  204  -10.2144   -28  59       u=204  imp:n=1  vol=78.9937  $ fuel
3452  4  -1.785E-4   28 -29  59     u=204  imp:n=1   $ gap
3453  2  -6.74       29 -30  59     u=204  imp:n=1   $ clad
3454  204  -10.2144   -31  59       u=204  imp:n=1  vol=78.9937  $ fuel
3455  4  -1.785E-4   31 -32  59     u=204  imp:n=1   $ gap
```

```
3456  2  -6.74       32 -33  59     u=204  imp:n=1   $ clad
3457  204  -10.2144   -34  59       u=204  imp:n=1  vol=78.9937  $ fuel
3458  4  -1.785E-4   34 -35  59     u=204  imp:n=1   $ gap
3459  2  -6.74       35 -36  59     u=204  imp:n=1   $ clad
3460  204  -10.2144   -37  59       u=204  imp:n=1  vol=78.9937  $ fuel
3461  4  -1.785E-4   37 -38  59     u=204  imp:n=1   $ gap
3462  2  -6.74       38 -39  59     u=204  imp:n=1   $ clad
3463  204  -10.2144   -40  59       u=204  imp:n=1  vol=78.9937  $ fuel
3464  4  -1.785E-4   40 -41  59     u=204  imp:n=1   $ gap
3465  2  -6.74       41 -42  59     u=204  imp:n=1   $ clad
3466  204  -10.2144   -43  59       u=204  imp:n=1  vol=78.9937  $ fuel
3467  4  -1.785E-4   43 -44  59     u=204  imp:n=1   $ gap
3468  2  -6.74       44 -45  59     u=204  imp:n=1   $ clad
3469  204  -10.2144   -46  59       u=204  imp:n=1  vol=78.9937  $ fuel
3470  4  -1.785E-4   46 -47  59     u=204  imp:n=1   $ gap
3471  2  -6.74       47 -48  59     u=204  imp:n=1   $ clad
3472  204  -10.2144   -49  59       u=204  imp:n=1  vol=78.9937  $ fuel
3473  4  -1.785E-4   49 -50  59     u=204  imp:n=1   $ gap
3474  2  -6.74       50 -51  59     u=204  imp:n=1   $ clad
3475  204  -10.2144   -52  59       u=204  imp:n=1  vol=78.9937  $ fuel
3476  4  -1.785E-4   52 -53  59     u=204  imp:n=1   $ gap
3477  2  -6.74       53 -54  59     u=204  imp:n=1   $ clad
3478  204  -10.2144   -55  59       u=204  imp:n=1  vol=78.9937  $ fuel
3479  4  -1.785E-4   55 -56  59     u=204  imp:n=1   $ gap
3480  2  -6.74       56 -57  59     u=204  imp:n=1   $ clad
3481  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=204  imp:n=1    $ D2O coolant
3482  3  -0.8143    -59 -60          u=204  imp:n=1    $ spacer
C      ********************************************************************
3483   211  -10.2144   -1  59        u=211  imp:n=1  vol=78.9937  $ fuel
3484   4  -1.785E-4   1 -2  59       u=211  imp:n=1   $ gap
3485   2  -6.74       2 -3  59       u=211  imp:n=1   $ clad
3486   211  -10.2144   -4  59        u=211  imp:n=1  vol=78.9937  $ fuel
3487   4  -1.785E-4   4 -5  59       u=211  imp:n=1   $ gap
3488   2  -6.74       5 -6  59       u=211  imp:n=1   $ clad
3489   211  -10.2144   -7  59        u=211  imp:n=1  vol=78.9937  $ fuel
3490   4  -1.785E-4   7 -8  59       u=211  imp:n=1   $ gap
3491   2  -6.74       8 -9  59       u=211  imp:n=1   $ clad
3492  211  -10.2144   -10   59      u=211  imp:n=1  vol=78.9937  $ fuel
3493  4  -1.785E-4   10 -11  59     u=211  imp:n=1   $ gap
3494  2  -6.74       11 -12  59     u=211  imp:n=1   $ clad
3495  211  -10.2144   -13  59       u=211  imp:n=1  vol=78.9937  $ fuel
3496  4  -1.785E-4   13 -14  59     u=211  imp:n=1   $ gap
3497  2  -6.74       14 -15  59     u=211  imp:n=1   $ clad
3498  211  -10.2144   -16  59       u=211  imp:n=1  vol=78.9937  $ fuel
3499  4  -1.785E-4   16 -17  59     u=211  imp:n=1   $ gap
3500  2  -6.74       17 -18  59     u=211  imp:n=1   $ clad
3501  211  -10.2144   -19  59       u=211  imp:n=1  vol=78.9937  $ fuel
3502  4  -1.785E-4   19 -20  59     u=211  imp:n=1   $ gap
3503  2  -6.74       20 -21  59     u=211  imp:n=1   $ clad
3504  211  -10.2144   -22  59       u=211  imp:n=1  vol=78.9937  $ fuel
3505  4  -1.785E-4   22 -23  59     u=211  imp:n=1   $ gap
3506  2  -6.74       23 -24  59     u=211  imp:n=1   $ clad
3507  211  -10.2144   -25  59       u=211  imp:n=1  vol=78.9937  $ fuel
3508  4  -1.785E-4   25 -26  59     u=211  imp:n=1   $ gap
```

```
3509  2  -6.74       26 -27  59     u=211  imp:n=1   $ clad
3510  211  -10.2144   -28  59       u=211  imp:n=1  vol=78.9937  $ fuel
3511  4  -1.785E-4   28 -29  59     u=211  imp:n=1   $ gap
3512  2  -6.74       29 -30  59     u=211  imp:n=1   $ clad
3513  211  -10.2144   -31  59       u=211  imp:n=1  vol=78.9937  $ fuel
3514  4  -1.785E-4   31 -32  59     u=211  imp:n=1   $ gap
3515  2  -6.74       32 -33  59     u=211  imp:n=1   $ clad
3516  211  -10.2144   -34  59       u=211  imp:n=1  vol=78.9937  $ fuel
3517  4  -1.785E-4   34 -35  59     u=211  imp:n=1   $ gap
3518  2  -6.74       35 -36  59     u=211  imp:n=1   $ clad
3519  211  -10.2144   -37  59       u=211  imp:n=1  vol=78.9937  $ fuel
3520  4  -1.785E-4   37 -38  59     u=211  imp:n=1   $ gap
3521  2  -6.74       38 -39  59     u=211  imp:n=1   $ clad
3522  211  -10.2144   -40  59       u=211  imp:n=1  vol=78.9937  $ fuel
3523  4  -1.785E-4   40 -41  59     u=211  imp:n=1   $ gap
3524  2  -6.74       41 -42  59     u=211  imp:n=1   $ clad
3525  211  -10.2144   -43  59       u=211  imp:n=1  vol=78.9937  $ fuel
3526  4  -1.785E-4   43 -44  59     u=211  imp:n=1   $ gap
3527  2  -6.74       44 -45  59     u=211  imp:n=1   $ clad
3528  211  -10.2144   -46  59       u=211  imp:n=1  vol=78.9937  $ fuel
3529  4  -1.785E-4   46 -47  59     u=211  imp:n=1   $ gap
3530  2  -6.74       47 -48  59     u=211  imp:n=1   $ clad
3531  211  -10.2144   -49  59       u=211  imp:n=1  vol=78.9937  $ fuel
3532  4  -1.785E-4   49 -50  59     u=211  imp:n=1   $ gap
3533  2  -6.74       50 -51  59     u=211  imp:n=1   $ clad
3534  211  -10.2144   -52  59       u=211  imp:n=1  vol=78.9937  $ fuel
3535  4  -1.785E-4   52 -53  59     u=211  imp:n=1   $ gap
3536  2  -6.74       53 -54  59     u=211  imp:n=1   $ clad
3537  211  -10.2144   -55  59       u=211  imp:n=1  vol=78.9937  $ fuel
3538  4  -1.785E-4   55 -56  59     u=211  imp:n=1   $ gap
3539  2  -6.74       56 -57  59     u=211  imp:n=1   $ clad
3540  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=211  imp:n=1    $ D2O coolant
3541  3  -0.8143    -59 -60          u=211  imp:n=1    $ spacer
C      ************************************************************
3542   212  -10.2144   -1  59        u=212  imp:n=1  vol=78.9937  $ fuel
3543   4  -1.785E-4   1 -2  59       u=212  imp:n=1   $ gap
3544   2  -6.74       2 -3  59       u=212  imp:n=1   $ clad
3545   212  -10.2144   -4  59        u=212  imp:n=1  vol=78.9937  $ fuel
3546   4  -1.785E-4   4 -5  59       u=212  imp:n=1   $ gap
3547   2  -6.74       5 -6  59       u=212  imp:n=1   $ clad
3548   212  -10.2144   -7  59        u=212  imp:n=1  vol=78.9937  $ fuel
3549   4  -1.785E-4   7 -8  59       u=212  imp:n=1   $ gap
3550   2  -6.74       8 -9  59       u=212  imp:n=1   $ clad
3551  212  -10.2144   -10   59      u=212  imp:n=1  vol=78.9937  $ fuel
3552  4  -1.785E-4   10 -11  59     u=212  imp:n=1   $ gap
3553  2  -6.74       11 -12  59     u=212  imp:n=1   $ clad
3554  212  -10.2144   -13  59       u=212  imp:n=1  vol=78.9937  $ fuel
3555  4  -1.785E-4   13 -14  59     u=212  imp:n=1   $ gap
3556  2  -6.74       14 -15  59     u=212  imp:n=1   $ clad
3557  212  -10.2144   -16  59       u=212  imp:n=1  vol=78.9937  $ fuel
3558  4  -1.785E-4   16 -17  59     u=212  imp:n=1   $ gap
3559  2  -6.74       17 -18  59     u=212  imp:n=1   $ clad
3560  212  -10.2144   -19  59       u=212  imp:n=1  vol=78.9937  $ fuel
3561  4  -1.785E-4   19 -20  59     u=212  imp:n=1   $ gap
```

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3562  2  -6.74       20 -21  59     u=212  imp:n=1   $ clad
3563  212  -10.2144   -22  59       u=212  imp:n=1  vol=78.9937  $ fuel
3564  4  -1.785E-4   22 -23  59     u=212  imp:n=1   $ gap
3565  2  -6.74       23 -24  59     u=212  imp:n=1   $ clad
3566  212  -10.2144   -25  59       u=212  imp:n=1  vol=78.9937  $ fuel
3567  4  -1.785E-4   25 -26  59     u=212  imp:n=1   $ gap
3568  2  -6.74       26 -27  59     u=212  imp:n=1   $ clad
3569  212  -10.2144   -28  59       u=212  imp:n=1  vol=78.9937  $ fuel
3570  4  -1.785E-4   28 -29  59     u=212  imp:n=1   $ gap
3571  2  -6.74       29 -30  59     u=212  imp:n=1   $ clad
3572  212  -10.2144   -31  59       u=212  imp:n=1  vol=78.9937  $ fuel
3573  4  -1.785E-4   31 -32  59     u=212  imp:n=1   $ gap
3574  2  -6.74       32 -33  59     u=212  imp:n=1   $ clad
3575  212  -10.2144   -34  59       u=212  imp:n=1  vol=78.9937  $ fuel
3576  4  -1.785E-4   34 -35  59     u=212  imp:n=1   $ gap
3577  2  -6.74       35 -36  59     u=212  imp:n=1   $ clad
3578  212  -10.2144   -37  59       u=212  imp:n=1  vol=78.9937  $ fuel
3579  4  -1.785E-4   37 -38  59     u=212  imp:n=1   $ gap
3580  2  -6.74       38 -39  59     u=212  imp:n=1   $ clad
3581  212  -10.2144   -40  59       u=212  imp:n=1  vol=78.9937  $ fuel
3582  4  -1.785E-4   40 -41  59     u=212  imp:n=1   $ gap
3583  2  -6.74       41 -42  59     u=212  imp:n=1   $ clad
3584  212  -10.2144   -43  59       u=212  imp:n=1  vol=78.9937  $ fuel
3585  4  -1.785E-4   43 -44  59     u=212  imp:n=1   $ gap
3586  2  -6.74       44 -45  59     u=212  imp:n=1   $ clad
3587  212  -10.2144   -46  59       u=212  imp:n=1  vol=78.9937  $ fuel
3588  4  -1.785E-4   46 -47  59     u=212  imp:n=1   $ gap
3589  2  -6.74       47 -48  59     u=212  imp:n=1   $ clad
3590  212  -10.2144   -49  59       u=212  imp:n=1  vol=78.9937  $ fuel
3591  4  -1.785E-4   49 -50  59     u=212  imp:n=1   $ gap
3592  2  -6.74       50 -51  59     u=212  imp:n=1   $ clad
3593  212  -10.2144   -52  59       u=212  imp:n=1  vol=78.9937  $ fuel
3594  4  -1.785E-4   52 -53  59     u=212  imp:n=1   $ gap
3595  2  -6.74       53 -54  59     u=212  imp:n=1   $ clad
3596  212  -10.2144   -55  59       u=212  imp:n=1  vol=78.9937  $ fuel
3597  4  -1.785E-4   55 -56  59     u=212  imp:n=1   $ gap
3598  2  -6.74       56 -57  59     u=212  imp:n=1   $ clad
3599  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=212  imp:n=1    $ D2O coolant
3600  3  -0.8143    -59 -60          u=212  imp:n=1    $ spacer
C      ***************************************************************
3601   214  -10.2144   -1  59        u=214  imp:n=1  vol=78.9937  $ fuel
3602   4  -1.785E-4   1 -2  59       u=214  imp:n=1   $ gap
3603   2  -6.74       2 -3  59       u=214  imp:n=1   $ clad
3604   214  -10.2144   -4  59        u=214  imp:n=1  vol=78.9937  $ fuel
3605   4  -1.785E-4   4 -5  59       u=214  imp:n=1   $ gap
3606   2  -6.74       5 -6  59       u=214  imp:n=1   $ clad
3607   214  -10.2144   -7  59        u=214  imp:n=1  vol=78.9937  $ fuel
3608   4  -1.785E-4   7 -8  59       u=214  imp:n=1   $ gap
3609   2  -6.74       8 -9  59       u=214  imp:n=1   $ clad
3610  214  -10.2144   -10   59      u=214  imp:n=1  vol=78.9937  $ fuel
3611  4  -1.785E-4   10 -11  59     u=214  imp:n=1   $ gap
3612  2  -6.74       11 -12  59     u=214  imp:n=1   $ clad
3613  214  -10.2144   -13  59       u=214  imp:n=1  vol=78.9937  $ fuel
3614  4  -1.785E-4   13 -14  59     u=214  imp:n=1   $ gap
```

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3615  2  -6.74       14 -15  59     u=214  imp:n=1   $ clad
3616  214  -10.2144   -16  59       u=214  imp:n=1  vol=78.9937  $ fuel
3617  4  -1.785E-4   16 -17  59     u=214  imp:n=1   $ gap
3618  2  -6.74       17 -18  59     u=214  imp:n=1   $ clad
3619  214  -10.2144   -19  59       u=214  imp:n=1  vol=78.9937  $ fuel
3620  4  -1.785E-4   19 -20  59     u=214  imp:n=1   $ gap
3621  2  -6.74       20 -21  59     u=214  imp:n=1   $ clad
3622  214  -10.2144   -22  59       u=214  imp:n=1  vol=78.9937  $ fuel
3623  4  -1.785E-4   22 -23  59     u=214  imp:n=1   $ gap
3624  2  -6.74       23 -24  59     u=214  imp:n=1   $ clad
3625  214  -10.2144   -25  59       u=214  imp:n=1  vol=78.9937  $ fuel
3626  4  -1.785E-4   25 -26  59     u=214  imp:n=1   $ gap
3627  2  -6.74       26 -27  59     u=214  imp:n=1   $ clad
3628  214  -10.2144   -28  59       u=214  imp:n=1  vol=78.9937  $ fuel
3629  4  -1.785E-4   28 -29  59     u=214  imp:n=1   $ gap
3630  2  -6.74       29 -30  59     u=214  imp:n=1   $ clad
3631  214  -10.2144   -31  59       u=214  imp:n=1  vol=78.9937  $ fuel
3632  4  -1.785E-4   31 -32  59     u=214  imp:n=1   $ gap
3633  2  -6.74       32 -33  59     u=214  imp:n=1   $ clad
3634  214  -10.2144   -34  59       u=214  imp:n=1  vol=78.9937  $ fuel
3635  4  -1.785E-4   34 -35  59     u=214  imp:n=1   $ gap
3636  2  -6.74       35 -36  59     u=214  imp:n=1   $ clad
3637  214  -10.2144   -37  59       u=214  imp:n=1  vol=78.9937  $ fuel
3638  4  -1.785E-4   37 -38  59     u=214  imp:n=1   $ gap
3639  2  -6.74       38 -39  59     u=214  imp:n=1   $ clad
3640  214  -10.2144   -40  59       u=214  imp:n=1  vol=78.9937  $ fuel
3641  4  -1.785E-4   40 -41  59     u=214  imp:n=1   $ gap
3642  2  -6.74       41 -42  59     u=214  imp:n=1   $ clad
3643  214  -10.2144   -43  59       u=214  imp:n=1  vol=78.9937  $ fuel
3644  4  -1.785E-4   43 -44  59     u=214  imp:n=1   $ gap
3645  2  -6.74       44 -45  59     u=214  imp:n=1   $ clad
3646  214  -10.2144   -46  59       u=214  imp:n=1  vol=78.9937  $ fuel
3647  4  -1.785E-4   46 -47  59     u=214  imp:n=1   $ gap
3648  2  -6.74       47 -48  59     u=214  imp:n=1   $ clad
3649  214  -10.2144   -49  59       u=214  imp:n=1  vol=78.9937  $ fuel
3650  4  -1.785E-4   49 -50  59     u=214  imp:n=1   $ gap
3651  2  -6.74       50 -51  59     u=214  imp:n=1   $ clad
3652  214  -10.2144   -52  59       u=214  imp:n=1  vol=78.9937  $ fuel
3653  4  -1.785E-4   52 -53  59     u=214  imp:n=1   $ gap
3654  2  -6.74       53 -54  59     u=214  imp:n=1   $ clad
3655  214  -10.2144   -55  59       u=214  imp:n=1  vol=78.9937  $ fuel
3656  4  -1.785E-4   55 -56  59     u=214  imp:n=1   $ gap
3657  2  -6.74       56 -57  59     u=214  imp:n=1   $ clad
3658  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=214  imp:n=1    $ D2O coolant
3659  3  -0.8143    -59 -60          u=214  imp:n=1    $ spacer
C      ************************************************************
3660   221  -10.2144   -1  59        u=221  imp:n=1  vol=78.9937  $ fuel
3661   4  -1.785E-4   1 -2  59       u=221  imp:n=1   $ gap
3662   2  -6.74       2 -3  59       u=221  imp:n=1   $ clad
3663   221  -10.2144   -4  59        u=221  imp:n=1  vol=78.9937  $ fuel
3664   4  -1.785E-4   4 -5  59       u=221  imp:n=1   $ gap
3665   2  -6.74       5 -6  59       u=221  imp:n=1   $ clad
3666   221  -10.2144   -7  59        u=221  imp:n=1  vol=78.9937  $ fuel
3667   4  -1.785E-4   7 -8  59       u=221  imp:n=1   $ gap
```

```
3668   2  -6.74       8 -9  59       u=221  imp:n=1   $ clad
3669  221 -10.2144   -10   59       u=221  imp:n=1  vol=78.9937  $ fuel
3670  4  -1.785E-4   10 -11  59     u=221  imp:n=1   $ gap
3671  2  -6.74       11 -12  59     u=221  imp:n=1   $ clad
3672  221  -10.2144   -13  59       u=221  imp:n=1  vol=78.9937  $ fuel
3673  4  -1.785E-4   13 -14  59     u=221  imp:n=1   $ gap
3674  2  -6.74       14 -15  59     u=221  imp:n=1   $ clad
3675  221  -10.2144   -16  59       u=221  imp:n=1  vol=78.9937  $ fuel
3676  4  -1.785E-4   16 -17  59     u=221  imp:n=1   $ gap
3677  2  -6.74       17 -18  59     u=221  imp:n=1   $ clad
3678  221  -10.2144   -19  59       u=221  imp:n=1  vol=78.9937  $ fuel
3679  4  -1.785E-4   19 -20  59     u=221  imp:n=1   $ gap
3680  2  -6.74       20 -21  59     u=221  imp:n=1   $ clad
3681  221  -10.2144   -22  59       u=221  imp:n=1  vol=78.9937  $ fuel
3682  4  -1.785E-4   22 -23  59     u=221  imp:n=1   $ gap
3683  2  -6.74       23 -24  59     u=221  imp:n=1   $ clad
3684  221  -10.2144   -25  59       u=221  imp:n=1  vol=78.9937  $ fuel
3685  4  -1.785E-4   25 -26  59     u=221  imp:n=1   $ gap
3686  2  -6.74       26 -27  59     u=221  imp:n=1   $ clad
3687  221  -10.2144   -28  59       u=221  imp:n=1  vol=78.9937  $ fuel
3688  4  -1.785E-4   28 -29  59     u=221  imp:n=1   $ gap
3689  2  -6.74       29 -30  59     u=221  imp:n=1   $ clad
3690  221  -10.2144   -31  59       u=221  imp:n=1  vol=78.9937  $ fuel
3691  4  -1.785E-4   31 -32  59     u=221  imp:n=1   $ gap
3692  2  -6.74       32 -33  59     u=221  imp:n=1   $ clad
3693  221  -10.2144   -34  59       u=221  imp:n=1  vol=78.9937  $ fuel
3694  4  -1.785E-4   34 -35  59     u=221  imp:n=1   $ gap
3695  2  -6.74       35 -36  59     u=221  imp:n=1   $ clad
3696  221  -10.2144   -37  59       u=221  imp:n=1  vol=78.9937  $ fuel
3697  4  -1.785E-4   37 -38  59     u=221  imp:n=1   $ gap
3698  2  -6.74       38 -39  59     u=221  imp:n=1   $ clad
3699  221  -10.2144   -40  59       u=221  imp:n=1  vol=78.9937  $ fuel
3700  4  -1.785E-4   40 -41  59     u=221  imp:n=1   $ gap
3701  2  -6.74       41 -42  59     u=221  imp:n=1   $ clad
3702  221  -10.2144   -43  59       u=221  imp:n=1  vol=78.9937  $ fuel
3703  4  -1.785E-4   43 -44  59     u=221  imp:n=1   $ gap
3704  2  -6.74       44 -45  59     u=221  imp:n=1   $ clad
3705  221  -10.2144   -46  59       u=221  imp:n=1  vol=78.9937  $ fuel
3706  4  -1.785E-4   46 -47  59     u=221  imp:n=1   $ gap
3707  2  -6.74       47 -48  59     u=221  imp:n=1   $ clad
3708  221  -10.2144   -49  59       u=221  imp:n=1  vol=78.9937  $ fuel
3709  4  -1.785E-4   49 -50  59     u=221  imp:n=1   $ gap
3710  2  -6.74       50 -51  59     u=221  imp:n=1   $ clad
3711  221  -10.2144   -52  59       u=221  imp:n=1  vol=78.9937  $ fuel
3712  4  -1.785E-4   52 -53  59     u=221  imp:n=1   $ gap
3713  2  -6.74       53 -54  59     u=221  imp:n=1   $ clad
3714  221  -10.2144   -55  59       u=221  imp:n=1  vol=78.9937  $ fuel
3715  4  -1.785E-4   55 -56  59     u=221  imp:n=1   $ gap
3716  2  -6.74       56 -57  59     u=221  imp:n=1   $ clad
3717  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=221  imp:n=1    $ D2O coolant
3718  3  -0.8143    -59 -60          u=221  imp:n=1    $ spacer
C      ***************************************************************
3719   222  -10.2144   -1  59        u=222  imp:n=1  vol=78.9937  $ fuel
3720   4  -1.785E-4   1 -2  59       u=222  imp:n=1   $ gap
```

```
3721   2  -6.74       2 -3  59       u=222  imp:n=1   $ clad
3722   222  -10.2144   -4  59       u=222  imp:n=1  vol=78.9937  $ fuel
3723   4  -1.785E-4   4 -5  59       u=222  imp:n=1   $ gap
3724   2  -6.74       5 -6  59       u=222  imp:n=1   $ clad
3725   222  -10.2144   -7  59       u=222  imp:n=1  vol=78.9937  $ fuel
3726   4  -1.785E-4   7 -8  59       u=222  imp:n=1   $ gap
3727   2  -6.74       8 -9  59       u=222  imp:n=1   $ clad
3728  222  -10.2144   -10   59      u=222  imp:n=1  vol=78.9937  $ fuel
3729  4  -1.785E-4   10 -11  59     u=222  imp:n=1   $ gap
3730  2  -6.74       11 -12  59     u=222  imp:n=1   $ clad
3731  222  -10.2144   -13  59       u=222  imp:n=1  vol=78.9937  $ fuel
3732  4  -1.785E-4   13 -14  59     u=222  imp:n=1   $ gap
3733  2  -6.74       14 -15  59     u=222  imp:n=1   $ clad
3734  222  -10.2144   -16  59       u=222  imp:n=1  vol=78.9937  $ fuel
3735  4  -1.785E-4   16 -17  59     u=222  imp:n=1   $ gap
3736  2  -6.74       17 -18  59     u=222  imp:n=1   $ clad
3737  222  -10.2144   -19  59       u=222  imp:n=1  vol=78.9937  $ fuel
3738  4  -1.785E-4   19 -20  59     u=222  imp:n=1   $ gap
3739  2  -6.74       20 -21  59     u=222  imp:n=1   $ clad
3740  222  -10.2144   -22  59       u=222  imp:n=1  vol=78.9937  $ fuel
3741  4  -1.785E-4   22 -23  59     u=222  imp:n=1   $ gap
3742  2  -6.74       23 -24  59     u=222  imp:n=1   $ clad
3743  222  -10.2144   -25  59       u=222  imp:n=1  vol=78.9937  $ fuel
3744  4  -1.785E-4   25 -26  59     u=222  imp:n=1   $ gap
3745  2  -6.74       26 -27  59     u=222  imp:n=1   $ clad
3746  222  -10.2144   -28  59       u=222  imp:n=1  vol=78.9937  $ fuel
3747  4  -1.785E-4   28 -29  59     u=222  imp:n=1   $ gap
3748  2  -6.74       29 -30  59     u=222  imp:n=1   $ clad
3749  222  -10.2144   -31  59       u=222  imp:n=1  vol=78.9937  $ fuel
3750  4  -1.785E-4   31 -32  59     u=222  imp:n=1   $ gap
3751  2  -6.74       32 -33  59     u=222  imp:n=1   $ clad
3752  222  -10.2144   -34  59       u=222  imp:n=1  vol=78.9937  $ fuel
3753  4  -1.785E-4   34 -35  59     u=222  imp:n=1   $ gap
3754  2  -6.74       35 -36  59     u=222  imp:n=1   $ clad
3755  222  -10.2144   -37  59       u=222  imp:n=1  vol=78.9937  $ fuel
3756  4  -1.785E-4   37 -38  59     u=222  imp:n=1   $ gap
3757  2  -6.74       38 -39  59     u=222  imp:n=1   $ clad
3758  222  -10.2144   -40  59       u=222  imp:n=1  vol=78.9937  $ fuel
3759  4  -1.785E-4   40 -41  59     u=222  imp:n=1   $ gap
3760  2  -6.74       41 -42  59     u=222  imp:n=1   $ clad
3761  222  -10.2144   -43  59       u=222  imp:n=1  vol=78.9937  $ fuel
3762  4  -1.785E-4   43 -44  59     u=222  imp:n=1   $ gap
3763  2  -6.74       44 -45  59     u=222  imp:n=1   $ clad
3764  222  -10.2144   -46  59       u=222  imp:n=1  vol=78.9937  $ fuel
3765  4  -1.785E-4   46 -47  59     u=222  imp:n=1   $ gap
3766  2  -6.74       47 -48  59     u=222  imp:n=1   $ clad
3767  222  -10.2144   -49  59       u=222  imp:n=1  vol=78.9937  $ fuel
3768  4  -1.785E-4   49 -50  59     u=222  imp:n=1   $ gap
3769  2  -6.74       50 -51  59     u=222  imp:n=1   $ clad
3770  222  -10.2144   -52  59       u=222  imp:n=1  vol=78.9937  $ fuel
3771  4  -1.785E-4   52 -53  59     u=222  imp:n=1   $ gap
3772  2  -6.74       53 -54  59     u=222  imp:n=1   $ clad
3773  222  -10.2144   -55  59       u=222  imp:n=1  vol=78.9937  $ fuel
3774  4  -1.785E-4   55 -56  59     u=222  imp:n=1   $ gap
3775  2  -6.74       56 -57  59     u=222  imp:n=1   $ clad
```

```
3776  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=222  imp:n=1    $ D2O coolant
3777  3  -0.8143    -59 -60          u=222  imp:n=1    $ spacer
C      ************************************************************
3778   224  -10.2144   -1  59        u=224  imp:n=1  vol=78.9937  $ fuel
3779   4  -1.785E-4   1 -2  59       u=224  imp:n=1   $ gap
3780   2  -6.74       2 -3  59       u=224  imp:n=1   $ clad
3781   224  -10.2144   -4  59        u=224  imp:n=1  vol=78.9937  $ fuel
3782   4  -1.785E-4   4 -5  59       u=224  imp:n=1   $ gap
3783   2  -6.74       5 -6  59       u=224  imp:n=1   $ clad
3784   224  -10.2144   -7  59        u=224  imp:n=1  vol=78.9937  $ fuel
3785   4  -1.785E-4   7 -8  59       u=224  imp:n=1   $ gap
3786   2  -6.74       8 -9  59       u=224  imp:n=1   $ clad
3787  224 -10.2144   -10   59       u=224  imp:n=1  vol=78.9937  $ fuel
3788  4  -1.785E-4   10 -11  59     u=224  imp:n=1   $ gap
3789  2  -6.74       11 -12  59     u=224  imp:n=1   $ clad
3790  224  -10.2144   -13  59       u=224  imp:n=1  vol=78.9937  $ fuel
3791  4  -1.785E-4   13 -14  59     u=224  imp:n=1   $ gap
3792  2  -6.74       14 -15  59     u=224  imp:n=1   $ clad
3793  224  -10.2144   -16  59       u=224  imp:n=1  vol=78.9937  $ fuel
3794  4  -1.785E-4   16 -17  59     u=224  imp:n=1   $ gap
3795  2  -6.74       17 -18  59     u=224  imp:n=1   $ clad
3796  224  -10.2144   -19  59       u=224  imp:n=1  vol=78.9937  $ fuel
3797  4  -1.785E-4   19 -20  59     u=224  imp:n=1   $ gap
3798  2  -6.74       20 -21  59     u=224  imp:n=1   $ clad
3799  224  -10.2144   -22  59       u=224  imp:n=1  vol=78.9937  $ fuel
3800  4  -1.785E-4   22 -23  59     u=224  imp:n=1   $ gap
3801  2  -6.74       23 -24  59     u=224  imp:n=1   $ clad
3802  224  -10.2144   -25  59       u=224  imp:n=1  vol=78.9937  $ fuel
3803  4  -1.785E-4   25 -26  59     u=224  imp:n=1   $ gap
3804  2  -6.74       26 -27  59     u=224  imp:n=1   $ clad
3805  224  -10.2144   -28  59       u=224  imp:n=1  vol=78.9937  $ fuel
3806  4  -1.785E-4   28 -29  59     u=224  imp:n=1   $ gap
3807  2  -6.74       29 -30  59     u=224  imp:n=1   $ clad
3808  224  -10.2144   -31  59       u=224  imp:n=1  vol=78.9937  $ fuel
3809  4  -1.785E-4   31 -32  59     u=224  imp:n=1   $ gap
3810  2  -6.74       32 -33  59     u=224  imp:n=1   $ clad
3811  224  -10.2144   -34  59       u=224  imp:n=1  vol=78.9937  $ fuel
3812  4  -1.785E-4   34 -35  59     u=224  imp:n=1   $ gap
3813  2  -6.74       35 -36  59     u=224  imp:n=1   $ clad
3814  224  -10.2144   -37  59       u=224  imp:n=1  vol=78.9937  $ fuel
3815  4  -1.785E-4   37 -38  59     u=224  imp:n=1   $ gap
3816  2  -6.74       38 -39  59     u=224  imp:n=1   $ clad
3817  224  -10.2144   -40  59       u=224  imp:n=1  vol=78.9937  $ fuel
3818  4  -1.785E-4   40 -41  59     u=224  imp:n=1   $ gap
3819  2  -6.74       41 -42  59     u=224  imp:n=1   $ clad
3820  224  -10.2144   -43  59       u=224  imp:n=1  vol=78.9937  $ fuel
3821  4  -1.785E-4   43 -44  59     u=224  imp:n=1   $ gap
3822  2  -6.74       44 -45  59     u=224  imp:n=1   $ clad
3823  224  -10.2144   -46  59       u=224  imp:n=1  vol=78.9937  $ fuel
3824  4  -1.785E-4   46 -47  59     u=224  imp:n=1   $ gap
3825  2  -6.74       47 -48  59     u=224  imp:n=1   $ clad
3826  224  -10.2144   -49  59       u=224  imp:n=1  vol=78.9937  $ fuel
3827  4  -1.785E-4   49 -50  59     u=224  imp:n=1   $ gap
3828  2  -6.74       50 -51  59     u=224  imp:n=1   $ clad
```

```
3829  224  -10.2144   -52  59       u=224  imp:n=1  vol=78.9937  $ fuel
3830  4  -1.785E-4   52 -53  59     u=224  imp:n=1   $ gap
3831  2  -6.74       53 -54  59     u=224  imp:n=1   $ clad
3832  224  -10.2144   -55  59       u=224  imp:n=1  vol=78.9937  $ fuel
3833  4  -1.785E-4   55 -56  59     u=224  imp:n=1   $ gap
3834  2  -6.74       56 -57  59     u=224  imp:n=1   $ clad
3835  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=224  imp:n=1    $ D2O coolant
3836  3  -0.8143    -59 -60          u=224  imp:n=1    $ spacer
C      ************************************************************
3837   231  -10.2144   -1  59        u=231  imp:n=1  vol=78.9937  $ fuel
3838   4  -1.785E-4   1 -2  59       u=231  imp:n=1   $ gap
3839   2  -6.74       2 -3  59       u=231  imp:n=1   $ clad
3840   231  -10.2144   -4  59        u=231  imp:n=1  vol=78.9937  $ fuel
3841   4  -1.785E-4   4 -5  59       u=231  imp:n=1   $ gap
3842   2  -6.74       5 -6  59       u=231  imp:n=1   $ clad
3843   231  -10.2144   -7  59        u=231  imp:n=1  vol=78.9937  $ fuel
3844   4  -1.785E-4   7 -8  59       u=231  imp:n=1   $ gap
3845   2  -6.74       8 -9  59       u=231  imp:n=1   $ clad
3846  231  -10.2144   -10   59      u=231  imp:n=1  vol=78.9937  $ fuel
3847  4  -1.785E-4   10 -11  59     u=231  imp:n=1   $ gap
3848  2  -6.74       11 -12  59     u=231  imp:n=1   $ clad
3849  231  -10.2144   -13  59       u=231  imp:n=1  vol=78.9937  $ fuel
3850  4  -1.785E-4   13 -14  59     u=231  imp:n=1   $ gap
3851  2  -6.74       14 -15  59     u=231  imp:n=1   $ clad
3852  231  -10.2144   -16  59       u=231  imp:n=1  vol=78.9937  $ fuel
3853  4  -1.785E-4   16 -17  59     u=231  imp:n=1   $ gap
3854  2  -6.74       17 -18  59     u=231  imp:n=1   $ clad
3855  231  -10.2144   -19  59       u=231  imp:n=1  vol=78.9937  $ fuel
3856  4  -1.785E-4   19 -20  59     u=231  imp:n=1   $ gap
3857  2  -6.74       20 -21  59     u=231  imp:n=1   $ clad
3858  231  -10.2144   -22  59       u=231  imp:n=1  vol=78.9937  $ fuel
3859  4  -1.785E-4   22 -23  59     u=231  imp:n=1   $ gap
3860  2  -6.74       23 -24  59     u=231  imp:n=1   $ clad
3861  231  -10.2144   -25  59       u=231  imp:n=1  vol=78.9937  $ fuel
3862  4  -1.785E-4   25 -26  59     u=231  imp:n=1   $ gap
3863  2  -6.74       26 -27  59     u=231  imp:n=1   $ clad
3864  231  -10.2144   -28  59       u=231  imp:n=1  vol=78.9937  $ fuel
3865  4  -1.785E-4   28 -29  59     u=231  imp:n=1   $ gap
3866  2  -6.74       29 -30  59     u=231  imp:n=1   $ clad
3867  231  -10.2144   -31  59       u=231  imp:n=1  vol=78.9937  $ fuel
3868  4  -1.785E-4   31 -32  59     u=231  imp:n=1   $ gap
3869  2  -6.74       32 -33  59     u=231  imp:n=1   $ clad
3870  231  -10.2144   -34  59       u=231  imp:n=1  vol=78.9937  $ fuel
3871  4  -1.785E-4   34 -35  59     u=231  imp:n=1   $ gap
3872  2  -6.74       35 -36  59     u=231  imp:n=1   $ clad
3873  231  -10.2144   -37  59       u=231  imp:n=1  vol=78.9937  $ fuel
3874  4  -1.785E-4   37 -38  59     u=231  imp:n=1   $ gap
3875  2  -6.74       38 -39  59     u=231  imp:n=1   $ clad
3876  231  -10.2144   -40  59       u=231  imp:n=1  vol=78.9937  $ fuel
3877  4  -1.785E-4   40 -41  59     u=231  imp:n=1   $ gap
3878  2  -6.74       41 -42  59     u=231  imp:n=1   $ clad
3879  231  -10.2144   -43  59       u=231  imp:n=1  vol=78.9937  $ fuel
3880  4  -1.785E-4   43 -44  59     u=231  imp:n=1   $ gap
3881  2  -6.74       44 -45  59     u=231  imp:n=1   $ clad
```

```
3882  231  -10.2144   -46  59       u=231  imp:n=1  vol=78.9937  $ fuel
3883  4  -1.785E-4   46 -47  59     u=231  imp:n=1   $ gap
3884  2  -6.74       47 -48  59     u=231  imp:n=1   $ clad
3885  231  -10.2144   -49  59       u=231  imp:n=1  vol=78.9937  $ fuel
3886  4  -1.785E-4   49 -50  59     u=231  imp:n=1   $ gap
3887  2  -6.74       50 -51  59     u=231  imp:n=1   $ clad
3888  231  -10.2144   -52  59       u=231  imp:n=1  vol=78.9937  $ fuel
3889  4  -1.785E-4   52 -53  59     u=231  imp:n=1   $ gap
3890  2  -6.74       53 -54  59     u=231  imp:n=1   $ clad
3891  231  -10.2144   -55  59       u=231  imp:n=1  vol=78.9937  $ fuel
3892  4  -1.785E-4   55 -56  59     u=231  imp:n=1   $ gap
3893  2  -6.74       56 -57  59     u=231  imp:n=1   $ clad
3894  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=231  imp:n=1    $ D2O coolant
3895  3  -0.8143    -59 -60          u=231  imp:n=1    $ spacer
C      ************************************************************
3896   232  -10.2144   -1  59        u=232  imp:n=1  vol=78.9937  $ fuel
3897   4  -1.785E-4   1 -2  59       u=232  imp:n=1   $ gap
3898   2  -6.74       2 -3  59       u=232  imp:n=1   $ clad
3899   232  -10.2144   -4  59        u=232  imp:n=1  vol=78.9937  $ fuel
3900   4  -1.785E-4   4 -5  59       u=232  imp:n=1   $ gap
3901   2  -6.74       5 -6  59       u=232  imp:n=1   $ clad
3902   232  -10.2144   -7  59        u=232  imp:n=1  vol=78.9937  $ fuel
3903   4  -1.785E-4   7 -8  59       u=232  imp:n=1   $ gap
3904   2  -6.74       8 -9  59       u=232  imp:n=1   $ clad
3905  232  -10.2144   -10   59      u=232  imp:n=1  vol=78.9937  $ fuel
3906  4  -1.785E-4   10 -11  59     u=232  imp:n=1   $ gap
3907  2  -6.74       11 -12  59     u=232  imp:n=1   $ clad
3908  232  -10.2144   -13  59       u=232  imp:n=1  vol=78.9937  $ fuel
3909  4  -1.785E-4   13 -14  59     u=232  imp:n=1   $ gap
3910  2  -6.74       14 -15  59     u=232  imp:n=1   $ clad
3911  232  -10.2144   -16  59       u=232  imp:n=1  vol=78.9937  $ fuel
3912  4  -1.785E-4   16 -17  59     u=232  imp:n=1   $ gap
3913  2  -6.74       17 -18  59     u=232  imp:n=1   $ clad
3914  232  -10.2144   -19  59       u=232  imp:n=1  vol=78.9937  $ fuel
3915  4  -1.785E-4   19 -20  59     u=232  imp:n=1   $ gap
3916  2  -6.74       20 -21  59     u=232  imp:n=1   $ clad
3917  232  -10.2144   -22  59       u=232  imp:n=1  vol=78.9937  $ fuel
3918  4  -1.785E-4   22 -23  59     u=232  imp:n=1   $ gap
3919  2  -6.74       23 -24  59     u=232  imp:n=1   $ clad
3920  232  -10.2144   -25  59       u=232  imp:n=1  vol=78.9937  $ fuel
3921  4  -1.785E-4   25 -26  59     u=232  imp:n=1   $ gap
3922  2  -6.74       26 -27  59     u=232  imp:n=1   $ clad
3923  232  -10.2144   -28  59       u=232  imp:n=1  vol=78.9937  $ fuel
3924  4  -1.785E-4   28 -29  59     u=232  imp:n=1   $ gap
3925  2  -6.74       29 -30  59     u=232  imp:n=1   $ clad
3926  232  -10.2144   -31  59       u=232  imp:n=1  vol=78.9937  $ fuel
3927  4  -1.785E-4   31 -32  59     u=232  imp:n=1   $ gap
3928  2  -6.74       32 -33  59     u=232  imp:n=1   $ clad
3929  232  -10.2144   -34  59       u=232  imp:n=1  vol=78.9937  $ fuel
3930  4  -1.785E-4   34 -35  59     u=232  imp:n=1   $ gap
3931  2  -6.74       35 -36  59     u=232  imp:n=1   $ clad
3932  232  -10.2144   -37  59       u=232  imp:n=1  vol=78.9937  $ fuel
3933  4  -1.785E-4   37 -38  59     u=232  imp:n=1   $ gap
3934  2  -6.74       38 -39  59     u=232  imp:n=1   $ clad
```

```
3935  232  -10.2144   -40  59       u=232  imp:n=1  vol=78.9937  $ fuel
3936  4  -1.785E-4   40 -41  59     u=232  imp:n=1   $ gap
3937  2  -6.74       41 -42  59     u=232  imp:n=1   $ clad
3938  232  -10.2144   -43  59       u=232  imp:n=1  vol=78.9937  $ fuel
3939  4  -1.785E-4   43 -44  59     u=232  imp:n=1   $ gap
3940  2  -6.74       44 -45  59     u=232  imp:n=1   $ clad
3941  232  -10.2144   -46  59       u=232  imp:n=1  vol=78.9937  $ fuel
3942  4  -1.785E-4   46 -47  59     u=232  imp:n=1   $ gap
3943  2  -6.74       47 -48  59     u=232  imp:n=1   $ clad
3944  232  -10.2144   -49  59       u=232  imp:n=1  vol=78.9937  $ fuel
3945  4  -1.785E-4   49 -50  59     u=232  imp:n=1   $ gap
3946  2  -6.74       50 -51  59     u=232  imp:n=1   $ clad
3947  232  -10.2144   -52  59       u=232  imp:n=1  vol=78.9937  $ fuel
3948  4  -1.785E-4   52 -53  59     u=232  imp:n=1   $ gap
3949  2  -6.74       53 -54  59     u=232  imp:n=1   $ clad
3950  232  -10.2144   -55  59       u=232  imp:n=1  vol=78.9937  $ fuel
3951  4  -1.785E-4   55 -56  59     u=232  imp:n=1   $ gap
3952  2  -6.74       56 -57  59     u=232  imp:n=1   $ clad
3953  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=232  imp:n=1    $ D2O coolant
3954  3  -0.8143    -59 -60          u=232  imp:n=1    $ spacer
C      ************************************************************************
3955   234  -10.2144   -1  59        u=234  imp:n=1  vol=78.9937  $ fuel
3956   4  -1.785E-4   1 -2  59       u=234  imp:n=1   $ gap
3957   2  -6.74       2 -3  59       u=234  imp:n=1   $ clad
3958   234  -10.2144   -4  59        u=234  imp:n=1  vol=78.9937  $ fuel
3959   4  -1.785E-4   4 -5  59       u=234  imp:n=1   $ gap
3960   2  -6.74       5 -6  59       u=234  imp:n=1   $ clad
3961   234  -10.2144   -7  59        u=234  imp:n=1  vol=78.9937  $ fuel
3962   4  -1.785E-4   7 -8  59       u=234  imp:n=1   $ gap
3963   2  -6.74       8 -9  59       u=234  imp:n=1   $ clad
3964  234  -10.2144   -10   59      u=234  imp:n=1  vol=78.9937  $ fuel
3965  4  -1.785E-4   10 -11  59     u=234  imp:n=1   $ gap
3966  2  -6.74       11 -12  59     u=234  imp:n=1   $ clad
3967  234  -10.2144   -13  59       u=234  imp:n=1  vol=78.9937  $ fuel
3968  4  -1.785E-4   13 -14  59     u=234  imp:n=1   $ gap
3969  2  -6.74       14 -15  59     u=234  imp:n=1   $ clad
3970  234  -10.2144   -16  59       u=234  imp:n=1  vol=78.9937  $ fuel
3971  4  -1.785E-4   16 -17  59     u=234  imp:n=1   $ gap
3972  2  -6.74       17 -18  59     u=234  imp:n=1   $ clad
3973  234  -10.2144   -19  59       u=234  imp:n=1  vol=78.9937  $ fuel
3974  4  -1.785E-4   19 -20  59     u=234  imp:n=1   $ gap
3975  2  -6.74       20 -21  59     u=234  imp:n=1   $ clad
3976  234  -10.2144   -22  59       u=234  imp:n=1  vol=78.9937  $ fuel
3977  4  -1.785E-4   22 -23  59     u=234  imp:n=1   $ gap
3978  2  -6.74       23 -24  59     u=234  imp:n=1   $ clad
3979  234  -10.2144   -25  59       u=234  imp:n=1  vol=78.9937  $ fuel
3980  4  -1.785E-4   25 -26  59     u=234  imp:n=1   $ gap
3981  2  -6.74       26 -27  59     u=234  imp:n=1   $ clad
3982  234  -10.2144   -28  59       u=234  imp:n=1  vol=78.9937  $ fuel
3983  4  -1.785E-4   28 -29  59     u=234  imp:n=1   $ gap
3984  2  -6.74       29 -30  59     u=234  imp:n=1   $ clad
3985  234  -10.2144   -31  59       u=234  imp:n=1  vol=78.9937  $ fuel
3986  4  -1.785E-4   31 -32  59     u=234  imp:n=1   $ gap
3987  2  -6.74       32 -33  59     u=234  imp:n=1   $ clad
```

```
3988  234  -10.2144   -34  59       u=234  imp:n=1  vol=78.9937  $ fuel
3989  4  -1.785E-4   34 -35  59     u=234  imp:n=1   $ gap
3990  2  -6.74       35 -36  59     u=234  imp:n=1   $ clad
3991  234  -10.2144   -37  59       u=234  imp:n=1  vol=78.9937  $ fuel
3992  4  -1.785E-4   37 -38  59     u=234  imp:n=1   $ gap
3993  2  -6.74       38 -39  59     u=234  imp:n=1   $ clad
3994  234  -10.2144   -40  59       u=234  imp:n=1  vol=78.9937  $ fuel
3995  4  -1.785E-4   40 -41  59     u=234  imp:n=1   $ gap
3996  2  -6.74       41 -42  59     u=234  imp:n=1   $ clad
3997  234  -10.2144   -43  59       u=234  imp:n=1  vol=78.9937  $ fuel
3998  4  -1.785E-4   43 -44  59     u=234  imp:n=1   $ gap
3999  2  -6.74       44 -45  59     u=234  imp:n=1   $ clad
4000  234  -10.2144   -46  59       u=234  imp:n=1  vol=78.9937  $ fuel
4001  4  -1.785E-4   46 -47  59     u=234  imp:n=1   $ gap
4002  2  -6.74       47 -48  59     u=234  imp:n=1   $ clad
4003  234  -10.2144   -49  59       u=234  imp:n=1  vol=78.9937  $ fuel
4004  4  -1.785E-4   49 -50  59     u=234  imp:n=1   $ gap
4005  2  -6.74       50 -51  59     u=234  imp:n=1   $ clad
4006  234  -10.2144   -52  59       u=234  imp:n=1  vol=78.9937  $ fuel
4007  4  -1.785E-4   52 -53  59     u=234  imp:n=1   $ gap
4008  2  -6.74       53 -54  59     u=234  imp:n=1   $ clad
4009  234  -10.2144   -55  59       u=234  imp:n=1  vol=78.9937  $ fuel
4010  4  -1.785E-4   55 -56  59     u=234  imp:n=1   $ gap
4011  2  -6.74       56 -57  59     u=234  imp:n=1   $ clad
4012  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=234  imp:n=1    $ D2O coolant
4013  3  -0.8143    -59 -60          u=234  imp:n=1    $ spacer
C      ********************************************************************
4014   241  -10.2144   -1  59        u=241  imp:n=1  vol=78.9937  $ fuel
4015   4  -1.785E-4   1 -2  59       u=241  imp:n=1   $ gap
4016   2  -6.74       2 -3  59       u=241  imp:n=1   $ clad
4017   241  -10.2144   -4  59        u=241  imp:n=1  vol=78.9937  $ fuel
4018   4  -1.785E-4   4 -5  59       u=241  imp:n=1   $ gap
4019   2  -6.74       5 -6  59       u=241  imp:n=1   $ clad
4020   241  -10.2144   -7  59        u=241  imp:n=1  vol=78.9937  $ fuel
4021   4  -1.785E-4   7 -8  59       u=241  imp:n=1   $ gap
4022   2  -6.74       8 -9  59       u=241  imp:n=1   $ clad
4023  241  -10.2144   -10   59      u=241  imp:n=1  vol=78.9937  $ fuel
4024  4  -1.785E-4   10 -11  59     u=241  imp:n=1   $ gap
4025  2  -6.74       11 -12  59     u=241  imp:n=1   $ clad
4026  241  -10.2144   -13  59       u=241  imp:n=1  vol=78.9937  $ fuel
4027  4  -1.785E-4   13 -14  59     u=241  imp:n=1   $ gap
4028  2  -6.74       14 -15  59     u=241  imp:n=1   $ clad
4029  241  -10.2144   -16  59       u=241  imp:n=1  vol=78.9937  $ fuel
4030  4  -1.785E-4   16 -17  59     u=241  imp:n=1   $ gap
4031  2  -6.74       17 -18  59     u=241  imp:n=1   $ clad
4032  241  -10.2144   -19  59       u=241  imp:n=1  vol=78.9937  $ fuel
4033  4  -1.785E-4   19 -20  59     u=241  imp:n=1   $ gap
4034  2  -6.74       20 -21  59     u=241  imp:n=1   $ clad
4035  241  -10.2144   -22  59       u=241  imp:n=1  vol=78.9937  $ fuel
4036  4  -1.785E-4   22 -23  59     u=241  imp:n=1   $ gap
4037  2  -6.74       23 -24  59     u=241  imp:n=1   $ clad
4038  241  -10.2144   -25  59       u=241  imp:n=1  vol=78.9937  $ fuel
4039  4  -1.785E-4   25 -26  59     u=241  imp:n=1   $ gap
4040  2  -6.74       26 -27  59     u=241  imp:n=1   $ clad
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4041  241  -10.2144   -28  59       u=241  imp:n=1  vol=78.9937  $ fuel
4042  4  -1.785E-4   28 -29  59     u=241  imp:n=1   $ gap
4043  2  -6.74       29 -30  59     u=241  imp:n=1   $ clad
4044  241  -10.2144   -31  59       u=241  imp:n=1  vol=78.9937  $ fuel
4045  4  -1.785E-4   31 -32  59     u=241  imp:n=1   $ gap
4046  2  -6.74       32 -33  59     u=241  imp:n=1   $ clad
4047  241  -10.2144   -34  59       u=241  imp:n=1  vol=78.9937  $ fuel
4048  4  -1.785E-4   34 -35  59     u=241  imp:n=1   $ gap
4049  2  -6.74       35 -36  59     u=241  imp:n=1   $ clad
4050  241  -10.2144   -37  59       u=241  imp:n=1  vol=78.9937  $ fuel
4051  4  -1.785E-4   37 -38  59     u=241  imp:n=1   $ gap
4052  2  -6.74       38 -39  59     u=241  imp:n=1   $ clad
4053  241  -10.2144   -40  59       u=241  imp:n=1  vol=78.9937  $ fuel
4054  4  -1.785E-4   40 -41  59     u=241  imp:n=1   $ gap
4055  2  -6.74       41 -42  59     u=241  imp:n=1   $ clad
4056  241  -10.2144   -43  59       u=241  imp:n=1  vol=78.9937  $ fuel
4057  4  -1.785E-4   43 -44  59     u=241  imp:n=1   $ gap
4058  2  -6.74       44 -45  59     u=241  imp:n=1   $ clad
4059  241  -10.2144   -46  59       u=241  imp:n=1  vol=78.9937  $ fuel
4060  4  -1.785E-4   46 -47  59     u=241  imp:n=1   $ gap
4061  2  -6.74       47 -48  59     u=241  imp:n=1   $ clad
4062  241  -10.2144   -49  59       u=241  imp:n=1  vol=78.9937  $ fuel
4063  4  -1.785E-4   49 -50  59     u=241  imp:n=1   $ gap
4064  2  -6.74       50 -51  59     u=241  imp:n=1   $ clad
4065  241  -10.2144   -52  59       u=241  imp:n=1  vol=78.9937  $ fuel
4066  4  -1.785E-4   52 -53  59     u=241  imp:n=1   $ gap
4067  2  -6.74       53 -54  59     u=241  imp:n=1   $ clad
4068  241  -10.2144   -55  59       u=241  imp:n=1  vol=78.9937  $ fuel
4069  4  -1.785E-4   55 -56  59     u=241  imp:n=1   $ gap
4070  2  -6.74       56 -57  59     u=241  imp:n=1   $ clad
4071  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=241  imp:n=1    $ D2O coolant
4072  3  -0.8143    -59 -60          u=241  imp:n=1    $ spacer
C      ************************************************************
4073   242  -10.2144   -1  59        u=242  imp:n=1  vol=78.9937  $ fuel
4074   4  -1.785E-4   1 -2  59       u=242  imp:n=1   $ gap
4075   2  -6.74       2 -3  59       u=242  imp:n=1   $ clad
4076   242  -10.2144   -4  59        u=242  imp:n=1  vol=78.9937  $ fuel
4077   4  -1.785E-4   4 -5  59       u=242  imp:n=1   $ gap
4078   2  -6.74       5 -6  59       u=242  imp:n=1   $ clad
4079   242  -10.2144   -7  59        u=242  imp:n=1  vol=78.9937  $ fuel
4080   4  -1.785E-4   7 -8  59       u=242  imp:n=1   $ gap
4081   2  -6.74       8 -9  59       u=242  imp:n=1   $ clad
4082  242  -10.2144   -10   59       u=242  imp:n=1  vol=78.9937  $ fuel
4083  4  -1.785E-4   10 -11  59     u=242  imp:n=1   $ gap
4084  2  -6.74       11 -12  59     u=242  imp:n=1   $ clad
4085  242  -10.2144   -13  59       u=242  imp:n=1  vol=78.9937  $ fuel
4086  4  -1.785E-4   13 -14  59     u=242  imp:n=1   $ gap
4087  2  -6.74       14 -15  59     u=242  imp:n=1   $ clad
4088  242  -10.2144   -16  59       u=242  imp:n=1  vol=78.9937  $ fuel
4089  4  -1.785E-4   16 -17  59     u=242  imp:n=1   $ gap
4090  2  -6.74       17 -18  59     u=242  imp:n=1   $ clad
4091  242  -10.2144   -19  59       u=242  imp:n=1  vol=78.9937  $ fuel
4092  4  -1.785E-4   19 -20  59     u=242  imp:n=1   $ gap
4093  2  -6.74       20 -21  59     u=242  imp:n=1   $ clad
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4094  242  -10.2144   -22  59       u=242  imp:n=1  vol=78.9937  $ fuel
4095  4  -1.785E-4   22 -23  59     u=242  imp:n=1   $ gap
4096  2  -6.74       23 -24  59     u=242  imp:n=1   $ clad
4097  242  -10.2144   -25  59       u=242  imp:n=1  vol=78.9937  $ fuel
4098  4  -1.785E-4   25 -26  59     u=242  imp:n=1   $ gap
4099  2  -6.74       26 -27  59     u=242  imp:n=1   $ clad
4100  242  -10.2144   -28  59       u=242  imp:n=1  vol=78.9937  $ fuel
4101  4  -1.785E-4   28 -29  59     u=242  imp:n=1   $ gap
4102  2  -6.74       29 -30  59     u=242  imp:n=1   $ clad
4103  242  -10.2144   -31  59       u=242  imp:n=1  vol=78.9937  $ fuel
4104  4  -1.785E-4   31 -32  59     u=242  imp:n=1   $ gap
4105  2  -6.74       32 -33  59     u=242  imp:n=1   $ clad
4106  242  -10.2144   -34  59       u=242  imp:n=1  vol=78.9937  $ fuel
4107  4  -1.785E-4   34 -35  59     u=242  imp:n=1   $ gap
4108  2  -6.74       35 -36  59     u=242  imp:n=1   $ clad
4109  242  -10.2144   -37  59       u=242  imp:n=1  vol=78.9937  $ fuel
4110  4  -1.785E-4   37 -38  59     u=242  imp:n=1   $ gap
4111  2  -6.74       38 -39  59     u=242  imp:n=1   $ clad
4112  242  -10.2144   -40  59       u=242  imp:n=1  vol=78.9937  $ fuel
4113  4  -1.785E-4   40 -41  59     u=242  imp:n=1   $ gap
4114  2  -6.74       41 -42  59     u=242  imp:n=1   $ clad
4115  242  -10.2144   -43  59       u=242  imp:n=1  vol=78.9937  $ fuel
4116  4  -1.785E-4   43 -44  59     u=242  imp:n=1   $ gap
4117  2  -6.74       44 -45  59     u=242  imp:n=1   $ clad
4118  242  -10.2144   -46  59       u=242  imp:n=1  vol=78.9937  $ fuel
4119  4  -1.785E-4   46 -47  59     u=242  imp:n=1   $ gap
4120  2  -6.74       47 -48  59     u=242  imp:n=1   $ clad
4121  242  -10.2144   -49  59       u=242  imp:n=1  vol=78.9937  $ fuel
4122  4  -1.785E-4   49 -50  59     u=242  imp:n=1   $ gap
4123  2  -6.74       50 -51  59     u=242  imp:n=1   $ clad
4124  242  -10.2144   -52  59       u=242  imp:n=1  vol=78.9937  $ fuel
4125  4  -1.785E-4   52 -53  59     u=242  imp:n=1   $ gap
4126  2  -6.74       53 -54  59     u=242  imp:n=1   $ clad
4127  242  -10.2144   -55  59       u=242  imp:n=1  vol=78.9937  $ fuel
4128  4  -1.785E-4   55 -56  59     u=242  imp:n=1   $ gap
4129  2  -6.74       56 -57  59     u=242  imp:n=1   $ clad
4130  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=242  imp:n=1    $ D2O coolant
4131  3  -0.8143    -59 -60          u=242  imp:n=1    $ spacer
C     ************************************************************
4132   244  -10.2144   -1  59        u=244  imp:n=1  vol=78.9937  $ fuel
4133   4  -1.785E-4   1 -2  59       u=244  imp:n=1   $ gap
4134   2  -6.74       2 -3  59       u=244  imp:n=1   $ clad
4135   244  -10.2144   -4  59        u=244  imp:n=1  vol=78.9937  $ fuel
4136   4  -1.785E-4   4 -5  59       u=244  imp:n=1   $ gap
4137   2  -6.74       5 -6  59       u=244  imp:n=1   $ clad
4138   244  -10.2144   -7  59        u=244  imp:n=1  vol=78.9937  $ fuel
4139   4  -1.785E-4   7 -8  59       u=244  imp:n=1   $ gap
4140   2  -6.74       8 -9  59       u=244  imp:n=1   $ clad
4141  244  -10.2144   -10   59      u=244  imp:n=1  vol=78.9937  $ fuel
4142  4  -1.785E-4   10 -11  59     u=244  imp:n=1   $ gap
4143  2  -6.74       11 -12  59     u=244  imp:n=1   $ clad
4144  244  -10.2144   -13  59       u=244  imp:n=1  vol=78.9937  $ fuel
4145  4  -1.785E-4   13 -14  59     u=244  imp:n=1   $ gap
4146  2  -6.74       14 -15  59     u=244  imp:n=1   $ clad
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4147  244  -10.2144   -16  59       u=244  imp:n=1  vol=78.9937  $ fuel
4148  4  -1.785E-4   16 -17  59     u=244  imp:n=1   $ gap
4149  2  -6.74       17 -18  59     u=244  imp:n=1   $ clad
4150  244  -10.2144   -19  59       u=244  imp:n=1  vol=78.9937  $ fuel
4151  4  -1.785E-4   19 -20  59     u=244  imp:n=1   $ gap
4152  2  -6.74       20 -21  59     u=244  imp:n=1   $ clad
4153  244  -10.2144   -22  59       u=244  imp:n=1  vol=78.9937  $ fuel
4154  4  -1.785E-4   22 -23  59     u=244  imp:n=1   $ gap
4155  2  -6.74       23 -24  59     u=244  imp:n=1   $ clad
4156  244  -10.2144   -25  59       u=244  imp:n=1  vol=78.9937  $ fuel
4157  4  -1.785E-4   25 -26  59     u=244  imp:n=1   $ gap
4158  2  -6.74       26 -27  59     u=244  imp:n=1   $ clad
4159  244  -10.2144   -28  59       u=244  imp:n=1  vol=78.9937  $ fuel
4160  4  -1.785E-4   28 -29  59     u=244  imp:n=1   $ gap
4161  2  -6.74       29 -30  59     u=244  imp:n=1   $ clad
4162  244  -10.2144   -31  59       u=244  imp:n=1  vol=78.9937  $ fuel
4163  4  -1.785E-4   31 -32  59     u=244  imp:n=1   $ gap
4164  2  -6.74       32 -33  59     u=244  imp:n=1   $ clad
4165  244  -10.2144   -34  59       u=244  imp:n=1  vol=78.9937  $ fuel
4166  4  -1.785E-4   34 -35  59     u=244  imp:n=1   $ gap
4167  2  -6.74       35 -36  59     u=244  imp:n=1   $ clad
4168  244  -10.2144   -37  59       u=244  imp:n=1  vol=78.9937  $ fuel
4169  4  -1.785E-4   37 -38  59     u=244  imp:n=1   $ gap
4170  2  -6.74       38 -39  59     u=244  imp:n=1   $ clad
4171  244  -10.2144   -40  59       u=244  imp:n=1  vol=78.9937  $ fuel
4172  4  -1.785E-4   40 -41  59     u=244  imp:n=1   $ gap
4173  2  -6.74       41 -42  59     u=244  imp:n=1   $ clad
4174  244  -10.2144   -43  59       u=244  imp:n=1  vol=78.9937  $ fuel
4175  4  -1.785E-4   43 -44  59     u=244  imp:n=1   $ gap
4176  2  -6.74       44 -45  59     u=244  imp:n=1   $ clad
4177  244  -10.2144   -46  59       u=244  imp:n=1  vol=78.9937  $ fuel
4178  4  -1.785E-4   46 -47  59     u=244  imp:n=1   $ gap
4179  2  -6.74       47 -48  59     u=244  imp:n=1   $ clad
4180  244  -10.2144   -49  59       u=244  imp:n=1  vol=78.9937  $ fuel
4181  4  -1.785E-4   49 -50  59     u=244  imp:n=1   $ gap
4182  2  -6.74       50 -51  59     u=244  imp:n=1   $ clad
4183  244  -10.2144   -52  59       u=244  imp:n=1  vol=78.9937  $ fuel
4184  4  -1.785E-4   52 -53  59     u=244  imp:n=1   $ gap
4185  2  -6.74       53 -54  59     u=244  imp:n=1   $ clad
4186  244  -10.2144   -55  59       u=244  imp:n=1  vol=78.9937  $ fuel
4187  4  -1.785E-4   55 -56  59     u=244  imp:n=1   $ gap
4188  2  -6.74       56 -57  59     u=244  imp:n=1   $ clad
4189  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=244  imp:n=1    $ D2O coolant
4190  3  -0.8143    -59 -60          u=244  imp:n=1    $ spacer
C      ************************************************************
4191   251  -10.2144   -1  59        u=251  imp:n=1  vol=78.9937  $ fuel
4192   4  -1.785E-4   1 -2  59       u=251  imp:n=1   $ gap
4193   2  -6.74       2 -3  59       u=251  imp:n=1   $ clad
4194   251  -10.2144   -4  59        u=251  imp:n=1  vol=78.9937  $ fuel
4195   4  -1.785E-4   4 -5  59       u=251  imp:n=1   $ gap
4196   2  -6.74       5 -6  59       u=251  imp:n=1   $ clad
4197   251  -10.2144   -7  59        u=251  imp:n=1  vol=78.9937  $ fuel
4198   4  -1.785E-4   7 -8  59       u=251  imp:n=1   $ gap
4199   2  -6.74       8 -9  59       u=251  imp:n=1   $ clad
```

```
4200  251  -10.2144   -10   59      u=251  imp:n=1  vol=78.9937  $ fuel
4201  4  -1.785E-4   10 -11  59     u=251  imp:n=1   $ gap
4202  2  -6.74       11 -12  59     u=251  imp:n=1   $ clad
4203  251  -10.2144   -13  59       u=251  imp:n=1  vol=78.9937  $ fuel
4204  4  -1.785E-4   13 -14  59     u=251  imp:n=1   $ gap
4205  2  -6.74       14 -15  59     u=251  imp:n=1   $ clad
4206  251  -10.2144   -16  59       u=251  imp:n=1  vol=78.9937  $ fuel
4207  4  -1.785E-4   16 -17  59     u=251  imp:n=1   $ gap
4208  2  -6.74       17 -18  59     u=251  imp:n=1   $ clad
4209  251  -10.2144   -19  59       u=251  imp:n=1  vol=78.9937  $ fuel
4210  4  -1.785E-4   19 -20  59     u=251  imp:n=1   $ gap
4211  2  -6.74       20 -21  59     u=251  imp:n=1   $ clad
4212  251  -10.2144   -22  59       u=251  imp:n=1  vol=78.9937  $ fuel
4213  4  -1.785E-4   22 -23  59     u=251  imp:n=1   $ gap
4214  2  -6.74       23 -24  59     u=251  imp:n=1   $ clad
4215  251  -10.2144   -25  59       u=251  imp:n=1  vol=78.9937  $ fuel
4216  4  -1.785E-4   25 -26  59     u=251  imp:n=1   $ gap
4217  2  -6.74       26 -27  59     u=251  imp:n=1   $ clad
4218  251  -10.2144   -28  59       u=251  imp:n=1  vol=78.9937  $ fuel
4219  4  -1.785E-4   28 -29  59     u=251  imp:n=1   $ gap
4220  2  -6.74       29 -30  59     u=251  imp:n=1   $ clad
4221  251  -10.2144   -31  59       u=251  imp:n=1  vol=78.9937  $ fuel
4222  4  -1.785E-4   31 -32  59     u=251  imp:n=1   $ gap
4223  2  -6.74       32 -33  59     u=251  imp:n=1   $ clad
4224  251  -10.2144   -34  59       u=251  imp:n=1  vol=78.9937  $ fuel
4225  4  -1.785E-4   34 -35  59     u=251  imp:n=1   $ gap
4226  2  -6.74       35 -36  59     u=251  imp:n=1   $ clad
4227  251  -10.2144   -37  59       u=251  imp:n=1  vol=78.9937  $ fuel
4228  4  -1.785E-4   37 -38  59     u=251  imp:n=1   $ gap
4229  2  -6.74       38 -39  59     u=251  imp:n=1   $ clad
4230  251  -10.2144   -40  59       u=251  imp:n=1  vol=78.9937  $ fuel
4231  4  -1.785E-4   40 -41  59     u=251  imp:n=1   $ gap
4232  2  -6.74       41 -42  59     u=251  imp:n=1   $ clad
4233  251  -10.2144   -43  59       u=251  imp:n=1  vol=78.9937  $ fuel
4234  4  -1.785E-4   43 -44  59     u=251  imp:n=1   $ gap
4235  2  -6.74       44 -45  59     u=251  imp:n=1   $ clad
4236  251  -10.2144   -46  59       u=251  imp:n=1  vol=78.9937  $ fuel
4237  4  -1.785E-4   46 -47  59     u=251  imp:n=1   $ gap
4238  2  -6.74       47 -48  59     u=251  imp:n=1   $ clad
4239  251  -10.2144   -49  59       u=251  imp:n=1  vol=78.9937  $ fuel
4240  4  -1.785E-4   49 -50  59     u=251  imp:n=1   $ gap
4241  2  -6.74       50 -51  59     u=251  imp:n=1   $ clad
4242  251  -10.2144   -52  59       u=251  imp:n=1  vol=78.9937  $ fuel
4243  4  -1.785E-4   52 -53  59     u=251  imp:n=1   $ gap
4244  2  -6.74       53 -54  59     u=251  imp:n=1   $ clad
4245  251  -10.2144   -55  59       u=251  imp:n=1  vol=78.9937  $ fuel
4246  4  -1.785E-4   55 -56  59     u=251  imp:n=1   $ gap
4247  2  -6.74       56 -57  59     u=251  imp:n=1   $ clad
4248  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=251  imp:n=1    $ D2O coolant
4249  3  -0.8143    -59 -60          u=251  imp:n=1    $ spacer
C      ************************************************************
4250   252  -10.2144   -1  59        u=252  imp:n=1  vol=78.9937  $ fuel
4251   4  -1.785E-4   1 -2  59       u=252  imp:n=1   $ gap
4252   2  -6.74       2 -3  59       u=252  imp:n=1   $ clad
```

```
4253   252  -10.2144   -4  59        u=252  imp:n=1  vol=78.9937  $ fuel
4254   4  -1.785E-4   4 -5  59       u=252  imp:n=1   $ gap
4255   2  -6.74       5 -6  59       u=252  imp:n=1   $ clad
4256   252  -10.2144   -7  59        u=252  imp:n=1  vol=78.9937  $ fuel
4257   4  -1.785E-4   7 -8  59       u=252  imp:n=1   $ gap
4258   2  -6.74       8 -9  59       u=252  imp:n=1   $ clad
4259  252  -10.2144   -10   59      u=252  imp:n=1  vol=78.9937  $ fuel
4260  4  -1.785E-4   10 -11  59     u=252  imp:n=1   $ gap
4261  2  -6.74       11 -12  59     u=252  imp:n=1   $ clad
4262  252  -10.2144   -13  59       u=252  imp:n=1  vol=78.9937  $ fuel
4263  4  -1.785E-4   13 -14  59     u=252  imp:n=1   $ gap
4264  2  -6.74       14 -15  59     u=252  imp:n=1   $ clad
4265  252  -10.2144   -16  59       u=252  imp:n=1  vol=78.9937  $ fuel
4266  4  -1.785E-4   16 -17  59     u=252  imp:n=1   $ gap
4267  2  -6.74       17 -18  59     u=252  imp:n=1   $ clad
4268  252  -10.2144   -19  59       u=252  imp:n=1  vol=78.9937  $ fuel
4269  4  -1.785E-4   19 -20  59     u=252  imp:n=1   $ gap
4270  2  -6.74       20 -21  59     u=252  imp:n=1   $ clad
4271  252  -10.2144   -22  59       u=252  imp:n=1  vol=78.9937  $ fuel
4272  4  -1.785E-4   22 -23  59     u=252  imp:n=1   $ gap
4273  2  -6.74       23 -24  59     u=252  imp:n=1   $ clad
4274  252  -10.2144   -25  59       u=252  imp:n=1  vol=78.9937  $ fuel
4275  4  -1.785E-4   25 -26  59     u=252  imp:n=1   $ gap
4276  2  -6.74       26 -27  59     u=252  imp:n=1   $ clad
4277  252  -10.2144   -28  59       u=252  imp:n=1  vol=78.9937  $ fuel
4278  4  -1.785E-4   28 -29  59     u=252  imp:n=1   $ gap
4279  2  -6.74       29 -30  59     u=252  imp:n=1   $ clad
4280  252  -10.2144   -31  59       u=252  imp:n=1  vol=78.9937  $ fuel
4281  4  -1.785E-4   31 -32  59     u=252  imp:n=1   $ gap
4282  2  -6.74       32 -33  59     u=252  imp:n=1   $ clad
4283  252  -10.2144   -34  59       u=252  imp:n=1  vol=78.9937  $ fuel
4284  4  -1.785E-4   34 -35  59     u=252  imp:n=1   $ gap
4285  2  -6.74       35 -36  59     u=252  imp:n=1   $ clad
4286  252  -10.2144   -37  59       u=252  imp:n=1  vol=78.9937  $ fuel
4287  4  -1.785E-4   37 -38  59     u=252  imp:n=1   $ gap
4288  2  -6.74       38 -39  59     u=252  imp:n=1   $ clad
4289  252  -10.2144   -40  59       u=252  imp:n=1  vol=78.9937  $ fuel
4290  4  -1.785E-4   40 -41  59     u=252  imp:n=1   $ gap
4291  2  -6.74       41 -42  59     u=252  imp:n=1   $ clad
4292  252  -10.2144   -43  59       u=252  imp:n=1  vol=78.9937  $ fuel
4293  4  -1.785E-4   43 -44  59     u=252  imp:n=1   $ gap
4294  2  -6.74       44 -45  59     u=252  imp:n=1   $ clad
4295  252  -10.2144   -46  59       u=252  imp:n=1  vol=78.9937  $ fuel
4296  4  -1.785E-4   46 -47  59     u=252  imp:n=1   $ gap
4297  2  -6.74       47 -48  59     u=252  imp:n=1   $ clad
4298  252  -10.2144   -49  59       u=252  imp:n=1  vol=78.9937  $ fuel
4299  4  -1.785E-4   49 -50  59     u=252  imp:n=1   $ gap
4300  2  -6.74       50 -51  59     u=252  imp:n=1   $ clad
4301  252  -10.2144   -52  59       u=252  imp:n=1  vol=78.9937  $ fuel
4302  4  -1.785E-4   52 -53  59     u=252  imp:n=1   $ gap
4303  2  -6.74       53 -54  59     u=252  imp:n=1   $ clad
4304  252  -10.2144   -55  59       u=252  imp:n=1  vol=78.9937  $ fuel
4305  4  -1.785E-4   55 -56  59     u=252  imp:n=1   $ gap
4306  2  -6.74       56 -57  59     u=252  imp:n=1   $ clad
4307  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
```

```
                      (-60 59)     u=252  imp:n=1    $ D2O coolant
4308  3  -0.8143    -59 -60          u=252  imp:n=1    $ spacer
C      ********************************************************************
4309   254  -10.2144   -1  59        u=254  imp:n=1  vol=78.9937  $ fuel
4310   4  -1.785E-4   1 -2  59       u=254  imp:n=1   $ gap
4311   2  -6.74       2 -3  59       u=254  imp:n=1   $ clad
4312   254  -10.2144   -4  59        u=254  imp:n=1  vol=78.9937  $ fuel
4313   4  -1.785E-4   4 -5  59       u=254  imp:n=1   $ gap
4314   2  -6.74       5 -6  59       u=254  imp:n=1   $ clad
4315   254  -10.2144   -7  59        u=254  imp:n=1  vol=78.9937  $ fuel
4316   4  -1.785E-4   7 -8  59       u=254  imp:n=1   $ gap
4317   2  -6.74       8 -9  59       u=254  imp:n=1   $ clad
4318  254  -10.2144   -10   59      u=254  imp:n=1  vol=78.9937  $ fuel
4319  4  -1.785E-4   10 -11  59     u=254  imp:n=1   $ gap
4320  2  -6.74       11 -12  59     u=254  imp:n=1   $ clad
4321  254  -10.2144   -13  59       u=254  imp:n=1  vol=78.9937  $ fuel
4322  4  -1.785E-4   13 -14  59     u=254  imp:n=1   $ gap
4323  2  -6.74       14 -15  59     u=254  imp:n=1   $ clad
4324  254  -10.2144   -16  59       u=254  imp:n=1  vol=78.9937  $ fuel
4325  4  -1.785E-4   16 -17  59     u=254  imp:n=1   $ gap
4326  2  -6.74       17 -18  59     u=254  imp:n=1   $ clad
4327  254  -10.2144   -19  59       u=254  imp:n=1  vol=78.9937  $ fuel
4328  4  -1.785E-4   19 -20  59     u=254  imp:n=1   $ gap
4329  2  -6.74       20 -21  59     u=254  imp:n=1   $ clad
4330  254  -10.2144   -22  59       u=254  imp:n=1  vol=78.9937  $ fuel
4331  4  -1.785E-4   22 -23  59     u=254  imp:n=1   $ gap
4332  2  -6.74       23 -24  59     u=254  imp:n=1   $ clad
4333  254  -10.2144   -25  59       u=254  imp:n=1  vol=78.9937  $ fuel
4334  4  -1.785E-4   25 -26  59     u=254  imp:n=1   $ gap
4335  2  -6.74       26 -27  59     u=254  imp:n=1   $ clad
4336  254  -10.2144   -28  59       u=254  imp:n=1  vol=78.9937  $ fuel
4337  4  -1.785E-4   28 -29  59     u=254  imp:n=1   $ gap
4338  2  -6.74       29 -30  59     u=254  imp:n=1   $ clad
4339  254  -10.2144   -31  59       u=254  imp:n=1  vol=78.9937  $ fuel
4340  4  -1.785E-4   31 -32  59     u=254  imp:n=1   $ gap
4341  2  -6.74       32 -33  59     u=254  imp:n=1   $ clad
4342  254  -10.2144   -34  59       u=254  imp:n=1  vol=78.9937  $ fuel
4343  4  -1.785E-4   34 -35  59     u=254  imp:n=1   $ gap
4344  2  -6.74       35 -36  59     u=254  imp:n=1   $ clad
4345  254  -10.2144   -37  59       u=254  imp:n=1  vol=78.9937  $ fuel
4346  4  -1.785E-4   37 -38  59     u=254  imp:n=1   $ gap
4347  2  -6.74       38 -39  59     u=254  imp:n=1   $ clad
4348  254  -10.2144   -40  59       u=254  imp:n=1  vol=78.9937  $ fuel
4349  4  -1.785E-4   40 -41  59     u=254  imp:n=1   $ gap
4350  2  -6.74       41 -42  59     u=254  imp:n=1   $ clad
4351  254  -10.2144   -43  59       u=254  imp:n=1  vol=78.9937  $ fuel
4352  4  -1.785E-4   43 -44  59     u=254  imp:n=1   $ gap
4353  2  -6.74       44 -45  59     u=254  imp:n=1   $ clad
4354  254  -10.2144   -46  59       u=254  imp:n=1  vol=78.9937  $ fuel
4355  4  -1.785E-4   46 -47  59     u=254  imp:n=1   $ gap
4356  2  -6.74       47 -48  59     u=254  imp:n=1   $ clad
4357  254  -10.2144   -49  59       u=254  imp:n=1  vol=78.9937  $ fuel
4358  4  -1.785E-4   49 -50  59     u=254  imp:n=1   $ gap
4359  2  -6.74       50 -51  59     u=254  imp:n=1   $ clad
4360  254  -10.2144   -52  59       u=254  imp:n=1  vol=78.9937  $ fuel
```

```
4361  4  -1.785E-4   52 -53  59     u=254  imp:n=1   $ gap
4362  2  -6.74       53 -54  59     u=254  imp:n=1   $ clad
4363  254  -10.2144   -55  59       u=254  imp:n=1  vol=78.9937  $ fuel
4364  4  -1.785E-4   55 -56  59     u=254  imp:n=1   $ gap
4365  2  -6.74       56 -57  59     u=254  imp:n=1   $ clad
4366  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=254  imp:n=1    $ D2O coolant
4367  3  -0.8143    -59 -60          u=254  imp:n=1    $ spacer
C      ********************************************************************
4368   261  -10.2144   -1  59        u=261  imp:n=1  vol=78.9937  $ fuel
4369   4  -1.785E-4   1 -2  59       u=261  imp:n=1   $ gap
4370   2  -6.74       2 -3  59       u=261  imp:n=1   $ clad
4371   261  -10.2144   -4  59        u=261  imp:n=1  vol=78.9937  $ fuel
4372   4  -1.785E-4   4 -5  59       u=261  imp:n=1   $ gap
4373   2  -6.74       5 -6  59       u=261  imp:n=1   $ clad
4374   261  -10.2144   -7  59        u=261  imp:n=1  vol=78.9937  $ fuel
4375   4  -1.785E-4   7 -8  59       u=261  imp:n=1   $ gap
4376   2  -6.74       8 -9  59       u=261  imp:n=1   $ clad
4377  261  -10.2144   -10   59      u=261  imp:n=1  vol=78.9937  $ fuel
4378  4  -1.785E-4   10 -11  59     u=261  imp:n=1   $ gap
4379  2  -6.74       11 -12  59     u=261  imp:n=1   $ clad
4380  261  -10.2144   -13  59       u=261  imp:n=1  vol=78.9937  $ fuel
4381  4  -1.785E-4   13 -14  59     u=261  imp:n=1   $ gap
4382  2  -6.74       14 -15  59     u=261  imp:n=1   $ clad
4383  261  -10.2144   -16  59       u=261  imp:n=1  vol=78.9937  $ fuel
4384  4  -1.785E-4   16 -17  59     u=261  imp:n=1   $ gap
4385  2  -6.74       17 -18  59     u=261  imp:n=1   $ clad
4386  261  -10.2144   -19  59       u=261  imp:n=1  vol=78.9937  $ fuel
4387  4  -1.785E-4   19 -20  59     u=261  imp:n=1   $ gap
4388  2  -6.74       20 -21  59     u=261  imp:n=1   $ clad
4389  261  -10.2144   -22  59       u=261  imp:n=1  vol=78.9937  $ fuel
4390  4  -1.785E-4   22 -23  59     u=261  imp:n=1   $ gap
4391  2  -6.74       23 -24  59     u=261  imp:n=1   $ clad
4392  261  -10.2144   -25  59       u=261  imp:n=1  vol=78.9937  $ fuel
4393  4  -1.785E-4   25 -26  59     u=261  imp:n=1   $ gap
4394  2  -6.74       26 -27  59     u=261  imp:n=1   $ clad
4395  261  -10.2144   -28  59       u=261  imp:n=1  vol=78.9937  $ fuel
4396  4  -1.785E-4   28 -29  59     u=261  imp:n=1   $ gap
4397  2  -6.74       29 -30  59     u=261  imp:n=1   $ clad
4398  261  -10.2144   -31  59       u=261  imp:n=1  vol=78.9937  $ fuel
4399  4  -1.785E-4   31 -32  59     u=261  imp:n=1   $ gap
4400  2  -6.74       32 -33  59     u=261  imp:n=1   $ clad
4401  261  -10.2144   -34  59       u=261  imp:n=1  vol=78.9937  $ fuel
4402  4  -1.785E-4   34 -35  59     u=261  imp:n=1   $ gap
4403  2  -6.74       35 -36  59     u=261  imp:n=1   $ clad
4404  261  -10.2144   -37  59       u=261  imp:n=1  vol=78.9937  $ fuel
4405  4  -1.785E-4   37 -38  59     u=261  imp:n=1   $ gap
4406  2  -6.74       38 -39  59     u=261  imp:n=1   $ clad
4407  261  -10.2144   -40  59       u=261  imp:n=1  vol=78.9937  $ fuel
4408  4  -1.785E-4   40 -41  59     u=261  imp:n=1   $ gap
4409  2  -6.74       41 -42  59     u=261  imp:n=1   $ clad
4410  261  -10.2144   -43  59       u=261  imp:n=1  vol=78.9937  $ fuel
4411  4  -1.785E-4   43 -44  59     u=261  imp:n=1   $ gap
4412  2  -6.74       44 -45  59     u=261  imp:n=1   $ clad
4413  261  -10.2144   -46  59       u=261  imp:n=1  vol=78.9937  $ fuel
```

```
4414  4  -1.785E-4   46 -47  59     u=261  imp:n=1   $ gap
4415  2  -6.74       47 -48  59     u=261  imp:n=1   $ clad
4416  261  -10.2144   -49  59       u=261  imp:n=1  vol=78.9937  $ fuel
4417  4  -1.785E-4   49 -50  59     u=261  imp:n=1   $ gap
4418  2  -6.74       50 -51  59     u=261  imp:n=1   $ clad
4419  261  -10.2144   -52  59       u=261  imp:n=1  vol=78.9937  $ fuel
4420  4  -1.785E-4   52 -53  59     u=261  imp:n=1   $ gap
4421  2  -6.74       53 -54  59     u=261  imp:n=1   $ clad
4422  261  -10.2144   -55  59       u=261  imp:n=1  vol=78.9937  $ fuel
4423  4  -1.785E-4   55 -56  59     u=261  imp:n=1   $ gap
4424  2  -6.74       56 -57  59     u=261  imp:n=1   $ clad
4425  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=261  imp:n=1    $ D2O coolant
4426  3  -0.8143    -59 -60          u=261  imp:n=1    $ spacer
C      ***************************************************************
4427   262  -10.2144   -1  59        u=262  imp:n=1  vol=78.9937  $ fuel
4428   4  -1.785E-4   1 -2  59       u=262  imp:n=1   $ gap
4429   2  -6.74       2 -3  59       u=262  imp:n=1   $ clad
4430   262  -10.2144   -4  59        u=262  imp:n=1  vol=78.9937  $ fuel
4431   4  -1.785E-4   4 -5  59       u=262  imp:n=1   $ gap
4432   2  -6.74       5 -6  59       u=262  imp:n=1   $ clad
4433   262  -10.2144   -7  59        u=262  imp:n=1  vol=78.9937  $ fuel
4434   4  -1.785E-4   7 -8  59       u=262  imp:n=1   $ gap
4435   2  -6.74       8 -9  59       u=262  imp:n=1   $ clad
4436  262  -10.2144   -10   59      u=262  imp:n=1  vol=78.9937  $ fuel
4437  4  -1.785E-4   10 -11  59     u=262  imp:n=1   $ gap
4438  2  -6.74       11 -12  59     u=262  imp:n=1   $ clad
4439  262  -10.2144   -13  59       u=262  imp:n=1  vol=78.9937  $ fuel
4440  4  -1.785E-4   13 -14  59     u=262  imp:n=1   $ gap
4441  2  -6.74       14 -15  59     u=262  imp:n=1   $ clad
4442  262  -10.2144   -16  59       u=262  imp:n=1  vol=78.9937  $ fuel
4443  4  -1.785E-4   16 -17  59     u=262  imp:n=1   $ gap
4444  2  -6.74       17 -18  59     u=262  imp:n=1   $ clad
4445  262  -10.2144   -19  59       u=262  imp:n=1  vol=78.9937  $ fuel
4446  4  -1.785E-4   19 -20  59     u=262  imp:n=1   $ gap
4447  2  -6.74       20 -21  59     u=262  imp:n=1   $ clad
4448  262  -10.2144   -22  59       u=262  imp:n=1  vol=78.9937  $ fuel
4449  4  -1.785E-4   22 -23  59     u=262  imp:n=1   $ gap
4450  2  -6.74       23 -24  59     u=262  imp:n=1   $ clad
4451  262  -10.2144   -25  59       u=262  imp:n=1  vol=78.9937  $ fuel
4452  4  -1.785E-4   25 -26  59     u=262  imp:n=1   $ gap
4453  2  -6.74       26 -27  59     u=262  imp:n=1   $ clad
4454  262  -10.2144   -28  59       u=262  imp:n=1  vol=78.9937  $ fuel
4455  4  -1.785E-4   28 -29  59     u=262  imp:n=1   $ gap
4456  2  -6.74       29 -30  59     u=262  imp:n=1   $ clad
4457  262  -10.2144   -31  59       u=262  imp:n=1  vol=78.9937  $ fuel
4458  4  -1.785E-4   31 -32  59     u=262  imp:n=1   $ gap
4459  2  -6.74       32 -33  59     u=262  imp:n=1   $ clad
4460  262  -10.2144   -34  59       u=262  imp:n=1  vol=78.9937  $ fuel
4461  4  -1.785E-4   34 -35  59     u=262  imp:n=1   $ gap
4462  2  -6.74       35 -36  59     u=262  imp:n=1   $ clad
4463  262  -10.2144   -37  59       u=262  imp:n=1  vol=78.9937  $ fuel
4464  4  -1.785E-4   37 -38  59     u=262  imp:n=1   $ gap
4465  2  -6.74       38 -39  59     u=262  imp:n=1   $ clad
4466  262  -10.2144   -40  59       u=262  imp:n=1  vol=78.9937  $ fuel
```

```
4467  4  -1.785E-4   40 -41  59     u=262  imp:n=1   $ gap
4468  2  -6.74       41 -42  59     u=262  imp:n=1   $ clad
4469  262  -10.2144   -43  59       u=262  imp:n=1  vol=78.9937  $ fuel
4470  4  -1.785E-4   43 -44  59     u=262  imp:n=1   $ gap
4471  2  -6.74       44 -45  59     u=262  imp:n=1   $ clad
4472  262  -10.2144   -46  59       u=262  imp:n=1  vol=78.9937  $ fuel
4473  4  -1.785E-4   46 -47  59     u=262  imp:n=1   $ gap
4474  2  -6.74       47 -48  59     u=262  imp:n=1   $ clad
4475  262  -10.2144   -49  59       u=262  imp:n=1  vol=78.9937  $ fuel
4476  4  -1.785E-4   49 -50  59     u=262  imp:n=1   $ gap
4477  2  -6.74       50 -51  59     u=262  imp:n=1   $ clad
4478  262  -10.2144   -52  59       u=262  imp:n=1  vol=78.9937  $ fuel
4479  4  -1.785E-4   52 -53  59     u=262  imp:n=1   $ gap
4480  2  -6.74       53 -54  59     u=262  imp:n=1   $ clad
4481  262  -10.2144   -55  59       u=262  imp:n=1  vol=78.9937  $ fuel
4482  4  -1.785E-4   55 -56  59     u=262  imp:n=1   $ gap
4483  2  -6.74       56 -57  59     u=262  imp:n=1   $ clad
4484  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=262  imp:n=1    $ D2O coolant
4485  3  -0.8143    -59 -60          u=262  imp:n=1    $ spacer
C      ************************************************************
4486   264  -10.2144   -1  59        u=264  imp:n=1  vol=78.9937  $ fuel
4487   4  -1.785E-4   1 -2  59       u=264  imp:n=1   $ gap
4488   2  -6.74       2 -3  59       u=264  imp:n=1   $ clad
4489   264  -10.2144   -4  59        u=264  imp:n=1  vol=78.9937  $ fuel
4490   4  -1.785E-4   4 -5  59       u=264  imp:n=1   $ gap
4491   2  -6.74       5 -6  59       u=264  imp:n=1   $ clad
4492   264  -10.2144   -7  59        u=264  imp:n=1  vol=78.9937  $ fuel
4493   4  -1.785E-4   7 -8  59       u=264  imp:n=1   $ gap
4494   2  -6.74       8 -9  59       u=264  imp:n=1   $ clad
4495  264  -10.2144   -10   59      u=264  imp:n=1  vol=78.9937  $ fuel
4496  4  -1.785E-4   10 -11  59     u=264  imp:n=1   $ gap
4497  2  -6.74       11 -12  59     u=264  imp:n=1   $ clad
4498  264  -10.2144   -13  59       u=264  imp:n=1  vol=78.9937  $ fuel
4499  4  -1.785E-4   13 -14  59     u=264  imp:n=1   $ gap
4500  2  -6.74       14 -15  59     u=264  imp:n=1   $ clad
4501  264  -10.2144   -16  59       u=264  imp:n=1  vol=78.9937  $ fuel
4502  4  -1.785E-4   16 -17  59     u=264  imp:n=1   $ gap
4503  2  -6.74       17 -18  59     u=264  imp:n=1   $ clad
4504  264  -10.2144   -19  59       u=264  imp:n=1  vol=78.9937  $ fuel
4505  4  -1.785E-4   19 -20  59     u=264  imp:n=1   $ gap
4506  2  -6.74       20 -21  59     u=264  imp:n=1   $ clad
4507  264  -10.2144   -22  59       u=264  imp:n=1  vol=78.9937  $ fuel
4508  4  -1.785E-4   22 -23  59     u=264  imp:n=1   $ gap
4509  2  -6.74       23 -24  59     u=264  imp:n=1   $ clad
4510  264  -10.2144   -25  59       u=264  imp:n=1  vol=78.9937  $ fuel
4511  4  -1.785E-4   25 -26  59     u=264  imp:n=1   $ gap
4512  2  -6.74       26 -27  59     u=264  imp:n=1   $ clad
4513  264  -10.2144   -28  59       u=264  imp:n=1  vol=78.9937  $ fuel
4514  4  -1.785E-4   28 -29  59     u=264  imp:n=1   $ gap
4515  2  -6.74       29 -30  59     u=264  imp:n=1   $ clad
4516  264  -10.2144   -31  59       u=264  imp:n=1  vol=78.9937  $ fuel
4517  4  -1.785E-4   31 -32  59     u=264  imp:n=1   $ gap
4518  2  -6.74       32 -33  59     u=264  imp:n=1   $ clad
4519  264  -10.2144   -34  59       u=264  imp:n=1  vol=78.9937  $ fuel
```

```
4520  4  -1.785E-4   34 -35  59     u=264  imp:n=1   $ gap
4521  2  -6.74       35 -36  59     u=264  imp:n=1   $ clad
4522  264  -10.2144   -37  59       u=264  imp:n=1  vol=78.9937  $ fuel
4523  4  -1.785E-4   37 -38  59     u=264  imp:n=1   $ gap
4524  2  -6.74       38 -39  59     u=264  imp:n=1   $ clad
4525  264  -10.2144   -40  59       u=264  imp:n=1  vol=78.9937  $ fuel
4526  4  -1.785E-4   40 -41  59     u=264  imp:n=1   $ gap
4527  2  -6.74       41 -42  59     u=264  imp:n=1   $ clad
4528  264  -10.2144   -43  59       u=264  imp:n=1  vol=78.9937  $ fuel
4529  4  -1.785E-4   43 -44  59     u=264  imp:n=1   $ gap
4530  2  -6.74       44 -45  59     u=264  imp:n=1   $ clad
4531  264  -10.2144   -46  59       u=264  imp:n=1  vol=78.9937  $ fuel
4532  4  -1.785E-4   46 -47  59     u=264  imp:n=1   $ gap
4533  2  -6.74       47 -48  59     u=264  imp:n=1   $ clad
4534  264  -10.2144   -49  59       u=264  imp:n=1  vol=78.9937  $ fuel
4535  4  -1.785E-4   49 -50  59     u=264  imp:n=1   $ gap
4536  2  -6.74       50 -51  59     u=264  imp:n=1   $ clad
4537  264  -10.2144   -52  59       u=264  imp:n=1  vol=78.9937  $ fuel
4538  4  -1.785E-4   52 -53  59     u=264  imp:n=1   $ gap
4539  2  -6.74       53 -54  59     u=264  imp:n=1   $ clad
4540  264  -10.2144   -55  59       u=264  imp:n=1  vol=78.9937  $ fuel
4541  4  -1.785E-4   55 -56  59     u=264  imp:n=1   $ gap
4542  2  -6.74       56 -57  59     u=264  imp:n=1   $ clad
4543  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=264  imp:n=1    $ D2O coolant
4544  3  -0.8143    -59 -60          u=264  imp:n=1    $ spacer
C      ********************************************************************
4545   271  -10.2144   -1  59        u=271  imp:n=1  vol=78.9937  $ fuel
4546   4  -1.785E-4   1 -2  59       u=271  imp:n=1   $ gap
4547   2  -6.74       2 -3  59       u=271  imp:n=1   $ clad
4548   271  -10.2144   -4  59        u=271  imp:n=1  vol=78.9937  $ fuel
4549   4  -1.785E-4   4 -5  59       u=271  imp:n=1   $ gap
4550   2  -6.74       5 -6  59       u=271  imp:n=1   $ clad
4551   271  -10.2144   -7  59        u=271  imp:n=1  vol=78.9937  $ fuel
4552   4  -1.785E-4   7 -8  59       u=271  imp:n=1   $ gap
4553   2  -6.74       8 -9  59       u=271  imp:n=1   $ clad
4554  271  -10.2144   -10   59      u=271  imp:n=1  vol=78.9937  $ fuel
4555  4  -1.785E-4   10 -11  59     u=271  imp:n=1   $ gap
4556  2  -6.74       11 -12  59     u=271  imp:n=1   $ clad
4557  271  -10.2144   -13  59       u=271  imp:n=1  vol=78.9937  $ fuel
4558  4  -1.785E-4   13 -14  59     u=271  imp:n=1   $ gap
4559  2  -6.74       14 -15  59     u=271  imp:n=1   $ clad
4560  271  -10.2144   -16  59       u=271  imp:n=1  vol=78.9937  $ fuel
4561  4  -1.785E-4   16 -17  59     u=271  imp:n=1   $ gap
4562  2  -6.74       17 -18  59     u=271  imp:n=1   $ clad
4563  271  -10.2144   -19  59       u=271  imp:n=1  vol=78.9937  $ fuel
4564  4  -1.785E-4   19 -20  59     u=271  imp:n=1   $ gap
4565  2  -6.74       20 -21  59     u=271  imp:n=1   $ clad
4566  271  -10.2144   -22  59       u=271  imp:n=1  vol=78.9937  $ fuel
4567  4  -1.785E-4   22 -23  59     u=271  imp:n=1   $ gap
4568  2  -6.74       23 -24  59     u=271  imp:n=1   $ clad
4569  271  -10.2144   -25  59       u=271  imp:n=1  vol=78.9937  $ fuel
4570  4  -1.785E-4   25 -26  59     u=271  imp:n=1   $ gap
4571  2  -6.74       26 -27  59     u=271  imp:n=1   $ clad
4572  271  -10.2144   -28  59       u=271  imp:n=1  vol=78.9937  $ fuel
```

```
4573  4  -1.785E-4   28 -29  59     u=271  imp:n=1   $ gap
4574  2  -6.74       29 -30  59     u=271  imp:n=1   $ clad
4575  271  -10.2144   -31  59       u=271  imp:n=1  vol=78.9937  $ fuel
4576  4  -1.785E-4   31 -32  59     u=271  imp:n=1   $ gap
4577  2  -6.74       32 -33  59     u=271  imp:n=1   $ clad
4578  271  -10.2144   -34  59       u=271  imp:n=1  vol=78.9937  $ fuel
4579  4  -1.785E-4   34 -35  59     u=271  imp:n=1   $ gap
4580  2  -6.74       35 -36  59     u=271  imp:n=1   $ clad
4581  271  -10.2144   -37  59       u=271  imp:n=1  vol=78.9937  $ fuel
4582  4  -1.785E-4   37 -38  59     u=271  imp:n=1   $ gap
4583  2  -6.74       38 -39  59     u=271  imp:n=1   $ clad
4584  271  -10.2144   -40  59       u=271  imp:n=1  vol=78.9937  $ fuel
4585  4  -1.785E-4   40 -41  59     u=271  imp:n=1   $ gap
4586  2  -6.74       41 -42  59     u=271  imp:n=1   $ clad
4587  271  -10.2144   -43  59       u=271  imp:n=1  vol=78.9937  $ fuel
4588  4  -1.785E-4   43 -44  59     u=271  imp:n=1   $ gap
4589  2  -6.74       44 -45  59     u=271  imp:n=1   $ clad
4590  271  -10.2144   -46  59       u=271  imp:n=1  vol=78.9937  $ fuel
4591  4  -1.785E-4   46 -47  59     u=271  imp:n=1   $ gap
4592  2  -6.74       47 -48  59     u=271  imp:n=1   $ clad
4593  271  -10.2144   -49  59       u=271  imp:n=1  vol=78.9937  $ fuel
4594  4  -1.785E-4   49 -50  59     u=271  imp:n=1   $ gap
4595  2  -6.74       50 -51  59     u=271  imp:n=1   $ clad
4596  271  -10.2144   -52  59       u=271  imp:n=1  vol=78.9937  $ fuel
4597  4  -1.785E-4   52 -53  59     u=271  imp:n=1   $ gap
4598  2  -6.74       53 -54  59     u=271  imp:n=1   $ clad
4599  271  -10.2144   -55  59       u=271  imp:n=1  vol=78.9937  $ fuel
4600  4  -1.785E-4   55 -56  59     u=271  imp:n=1   $ gap
4601  2  -6.74       56 -57  59     u=271  imp:n=1   $ clad
4602  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                      (-60 59)     u=271  imp:n=1    $ D2O coolant
4603  3  -0.8143    -59 -60          u=271  imp:n=1    $ spacer
C      ************************************************************
4604   272  -10.2144   -1  59        u=272  imp:n=1  vol=78.9937  $ fuel
4605   4  -1.785E-4   1 -2  59       u=272  imp:n=1   $ gap
4606   2  -6.74       2 -3  59       u=272  imp:n=1   $ clad
4607   272  -10.2144   -4  59        u=272  imp:n=1  vol=78.9937  $ fuel
4608   4  -1.785E-4   4 -5  59       u=272  imp:n=1   $ gap
4609   2  -6.74       5 -6  59       u=272  imp:n=1   $ clad
4610   272  -10.2144   -7  59        u=272  imp:n=1  vol=78.9937  $ fuel
4611   4  -1.785E-4   7 -8  59       u=272  imp:n=1   $ gap
4612   2  -6.74       8 -9  59       u=272  imp:n=1   $ clad
4613  272  -10.2144   -10   59      u=272  imp:n=1  vol=78.9937  $ fuel
4614  4  -1.785E-4   10 -11  59     u=272  imp:n=1   $ gap
4615  2  -6.74       11 -12  59     u=272  imp:n=1   $ clad
4616  272  -10.2144   -13  59       u=272  imp:n=1  vol=78.9937  $ fuel
4617  4  -1.785E-4   13 -14  59     u=272  imp:n=1   $ gap
4618  2  -6.74       14 -15  59     u=272  imp:n=1   $ clad
4619  272  -10.2144   -16  59       u=272  imp:n=1  vol=78.9937  $ fuel
4620  4  -1.785E-4   16 -17  59     u=272  imp:n=1   $ gap
4621  2  -6.74       17 -18  59     u=272  imp:n=1   $ clad
4622  272  -10.2144   -19  59       u=272  imp:n=1  vol=78.9937  $ fuel
4623  4  -1.785E-4   19 -20  59     u=272  imp:n=1   $ gap
4624  2  -6.74       20 -21  59     u=272  imp:n=1   $ clad
4625  272  -10.2144   -22  59       u=272  imp:n=1  vol=78.9937  $ fuel
```

```
4626  4  -1.785E-4   22 -23  59     u=272  imp:n=1   $ gap
4627  2  -6.74       23 -24  59     u=272  imp:n=1   $ clad
4628  272  -10.2144   -25  59       u=272  imp:n=1  vol=78.9937  $ fuel
4629  4  -1.785E-4   25 -26  59     u=272  imp:n=1   $ gap
4630  2  -6.74       26 -27  59     u=272  imp:n=1   $ clad
4631  272  -10.2144   -28  59       u=272  imp:n=1  vol=78.9937  $ fuel
4632  4  -1.785E-4   28 -29  59     u=272  imp:n=1   $ gap
4633  2  -6.74       29 -30  59     u=272  imp:n=1   $ clad
4634  272  -10.2144   -31  59       u=272  imp:n=1  vol=78.9937  $ fuel
4635  4  -1.785E-4   31 -32  59     u=272  imp:n=1   $ gap
4636  2  -6.74       32 -33  59     u=272  imp:n=1   $ clad
4637  272  -10.2144   -34  59       u=272  imp:n=1  vol=78.9937  $ fuel
4638  4  -1.785E-4   34 -35  59     u=272  imp:n=1   $ gap
4639  2  -6.74       35 -36  59     u=272  imp:n=1   $ clad
4640  272  -10.2144   -37  59       u=272  imp:n=1  vol=78.9937  $ fuel
4641  4  -1.785E-4   37 -38  59     u=272  imp:n=1   $ gap
4642  2  -6.74       38 -39  59     u=272  imp:n=1   $ clad
4643  272  -10.2144   -40  59       u=272  imp:n=1  vol=78.9937  $ fuel
4644  4  -1.785E-4   40 -41  59     u=272  imp:n=1   $ gap
4645  2  -6.74       41 -42  59     u=272  imp:n=1   $ clad
4646  272  -10.2144   -43  59       u=272  imp:n=1  vol=78.9937  $ fuel
4647  4  -1.785E-4   43 -44  59     u=272  imp:n=1   $ gap
4648  2  -6.74       44 -45  59     u=272  imp:n=1   $ clad
4649  272  -10.2144   -46  59       u=272  imp:n=1  vol=78.9937  $ fuel
4650  4  -1.785E-4   46 -47  59     u=272  imp:n=1   $ gap
4651  2  -6.74       47 -48  59     u=272  imp:n=1   $ clad
4652  272  -10.2144   -49  59       u=272  imp:n=1  vol=78.9937  $ fuel
4653  4  -1.785E-4   49 -50  59     u=272  imp:n=1   $ gap
4654  2  -6.74       50 -51  59     u=272  imp:n=1   $ clad
4655  272  -10.2144   -52  59       u=272  imp:n=1  vol=78.9937  $ fuel
4656  4  -1.785E-4   52 -53  59     u=272  imp:n=1   $ gap
4657  2  -6.74       53 -54  59     u=272  imp:n=1   $ clad
4658  272  -10.2144   -55  59       u=272  imp:n=1  vol=78.9937  $ fuel
4659  4  -1.785E-4   55 -56  59     u=272  imp:n=1   $ gap
4660  2  -6.74       56 -57  59     u=272  imp:n=1   $ clad
4661  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=272  imp:n=1    $ D2O coolant
4662  3  -0.8143    -59 -60          u=272  imp:n=1    $ spacer
C      ************************************************************************
4663   274  -10.2144   -1  59        u=274  imp:n=1  vol=78.9937  $ fuel
4664   4  -1.785E-4   1 -2  59       u=274  imp:n=1   $ gap
4665   2  -6.74       2 -3  59       u=274  imp:n=1   $ clad
4666   274  -10.2144   -4  59        u=274  imp:n=1  vol=78.9937  $ fuel
4667   4  -1.785E-4   4 -5  59       u=274  imp:n=1   $ gap
4668   2  -6.74       5 -6  59       u=274  imp:n=1   $ clad
4669   274  -10.2144   -7  59        u=274  imp:n=1  vol=78.9937  $ fuel
4670   4  -1.785E-4   7 -8  59       u=274  imp:n=1   $ gap
4671   2  -6.74       8 -9  59       u=274  imp:n=1   $ clad
4672  274  -10.2144   -10   59      u=274  imp:n=1  vol=78.9937  $ fuel
4673  4  -1.785E-4   10 -11  59     u=274  imp:n=1   $ gap
4674  2  -6.74       11 -12  59     u=274  imp:n=1   $ clad
4675  274  -10.2144   -13  59       u=274  imp:n=1  vol=78.9937  $ fuel
4676  4  -1.785E-4   13 -14  59     u=274  imp:n=1   $ gap
4677  2  -6.74       14 -15  59     u=274  imp:n=1   $ clad
4678  274  -10.2144   -16  59       u=274  imp:n=1  vol=78.9937  $ fuel
```

```
4679  4  -1.785E-4   16 -17  59     u=274  imp:n=1   $ gap
4680  2  -6.74       17 -18  59     u=274  imp:n=1   $ clad
4681  274  -10.2144   -19  59       u=274  imp:n=1  vol=78.9937  $ fuel
4682  4  -1.785E-4   19 -20  59     u=274  imp:n=1   $ gap
4683  2  -6.74       20 -21  59     u=274  imp:n=1   $ clad
4684  274  -10.2144   -22  59       u=274  imp:n=1  vol=78.9937  $ fuel
4685  4  -1.785E-4   22 -23  59     u=274  imp:n=1   $ gap
4686  2  -6.74       23 -24  59     u=274  imp:n=1   $ clad
4687  274  -10.2144   -25  59       u=274  imp:n=1  vol=78.9937  $ fuel
4688  4  -1.785E-4   25 -26  59     u=274  imp:n=1   $ gap
4689  2  -6.74       26 -27  59     u=274  imp:n=1   $ clad
4690  274  -10.2144   -28  59       u=274  imp:n=1  vol=78.9937  $ fuel
4691  4  -1.785E-4   28 -29  59     u=274  imp:n=1   $ gap
4692  2  -6.74       29 -30  59     u=274  imp:n=1   $ clad
4693  274  -10.2144   -31  59       u=274  imp:n=1  vol=78.9937  $ fuel
4694  4  -1.785E-4   31 -32  59     u=274  imp:n=1   $ gap
4695  2  -6.74       32 -33  59     u=274  imp:n=1   $ clad
4696  274  -10.2144   -34  59       u=274  imp:n=1  vol=78.9937  $ fuel
4697  4  -1.785E-4   34 -35  59     u=274  imp:n=1   $ gap
4698  2  -6.74       35 -36  59     u=274  imp:n=1   $ clad
4699  274  -10.2144   -37  59       u=274  imp:n=1  vol=78.9937  $ fuel
4700  4  -1.785E-4   37 -38  59     u=274  imp:n=1   $ gap
4701  2  -6.74       38 -39  59     u=274  imp:n=1   $ clad
4702  274  -10.2144   -40  59       u=274  imp:n=1  vol=78.9937  $ fuel
4703  4  -1.785E-4   40 -41  59     u=274  imp:n=1   $ gap
4704  2  -6.74       41 -42  59     u=274  imp:n=1   $ clad
4705  274  -10.2144   -43  59       u=274  imp:n=1  vol=78.9937  $ fuel
4706  4  -1.785E-4   43 -44  59     u=274  imp:n=1   $ gap
4707  2  -6.74       44 -45  59     u=274  imp:n=1   $ clad
4708  274  -10.2144   -46  59       u=274  imp:n=1  vol=78.9937  $ fuel
4709  4  -1.785E-4   46 -47  59     u=274  imp:n=1   $ gap
4710  2  -6.74       47 -48  59     u=274  imp:n=1   $ clad
4711  274  -10.2144   -49  59       u=274  imp:n=1  vol=78.9937  $ fuel
4712  4  -1.785E-4   49 -50  59     u=274  imp:n=1   $ gap
4713  2  -6.74       50 -51  59     u=274  imp:n=1   $ clad
4714  274  -10.2144   -52  59       u=274  imp:n=1  vol=78.9937  $ fuel
4715  4  -1.785E-4   52 -53  59     u=274  imp:n=1   $ gap
4716  2  -6.74       53 -54  59     u=274  imp:n=1   $ clad
4717  274  -10.2144   -55  59       u=274  imp:n=1  vol=78.9937  $ fuel
4718  4  -1.785E-4   55 -56  59     u=274  imp:n=1   $ gap
4719  2  -6.74       56 -57  59     u=274  imp:n=1   $ clad
4720  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=274  imp:n=1    $ D2O coolant
4721  3  -0.8143    -59 -60          u=274  imp:n=1    $ spacer
C      ************************************************************
4722   281  -10.2144   -1  59        u=281  imp:n=1  vol=78.9937  $ fuel
4723   4  -1.785E-4   1 -2  59       u=281  imp:n=1   $ gap
4724   2  -6.74       2 -3  59       u=281  imp:n=1   $ clad
4725   281  -10.2144   -4  59        u=281  imp:n=1  vol=78.9937  $ fuel
4726   4  -1.785E-4   4 -5  59       u=281  imp:n=1   $ gap
4727   2  -6.74       5 -6  59       u=281  imp:n=1   $ clad
4728   281  -10.2144   -7  59        u=281  imp:n=1  vol=78.9937  $ fuel
4729   4  -1.785E-4   7 -8  59       u=281  imp:n=1   $ gap
4730   2  -6.74       8 -9  59       u=281  imp:n=1   $ clad
4731  281  -10.2144   -10   59      u=281  imp:n=1  vol=78.9937  $ fuel
```

```
4732  4  -1.785E-4   10 -11  59     u=281  imp:n=1   $ gap
4733  2  -6.74       11 -12  59     u=281  imp:n=1   $ clad
4734  281  -10.2144   -13  59       u=281  imp:n=1  vol=78.9937  $ fuel
4735  4  -1.785E-4   13 -14  59     u=281  imp:n=1   $ gap
4736  2  -6.74       14 -15  59     u=281  imp:n=1   $ clad
4737  281  -10.2144   -16  59       u=281  imp:n=1  vol=78.9937  $ fuel
4738  4  -1.785E-4   16 -17  59     u=281  imp:n=1   $ gap
4739  2  -6.74       17 -18  59     u=281  imp:n=1   $ clad
4740  281  -10.2144   -19  59       u=281  imp:n=1  vol=78.9937  $ fuel
4741  4  -1.785E-4   19 -20  59     u=281  imp:n=1   $ gap
4742  2  -6.74       20 -21  59     u=281  imp:n=1   $ clad
4743  281  -10.2144   -22  59       u=281  imp:n=1  vol=78.9937  $ fuel
4744  4  -1.785E-4   22 -23  59     u=281  imp:n=1   $ gap
4745  2  -6.74       23 -24  59     u=281  imp:n=1   $ clad
4746  281  -10.2144   -25  59       u=281  imp:n=1  vol=78.9937  $ fuel
4747  4  -1.785E-4   25 -26  59     u=281  imp:n=1   $ gap
4748  2  -6.74       26 -27  59     u=281  imp:n=1   $ clad
4749  281  -10.2144   -28  59       u=281  imp:n=1  vol=78.9937  $ fuel
4750  4  -1.785E-4   28 -29  59     u=281  imp:n=1   $ gap
4751  2  -6.74       29 -30  59     u=281  imp:n=1   $ clad
4752  281  -10.2144   -31  59       u=281  imp:n=1  vol=78.9937  $ fuel
4753  4  -1.785E-4   31 -32  59     u=281  imp:n=1   $ gap
4754  2  -6.74       32 -33  59     u=281  imp:n=1   $ clad
4755  281  -10.2144   -34  59       u=281  imp:n=1  vol=78.9937  $ fuel
4756  4  -1.785E-4   34 -35  59     u=281  imp:n=1   $ gap
4757  2  -6.74       35 -36  59     u=281  imp:n=1   $ clad
4758  281  -10.2144   -37  59       u=281  imp:n=1  vol=78.9937  $ fuel
4759  4  -1.785E-4   37 -38  59     u=281  imp:n=1   $ gap
4760  2  -6.74       38 -39  59     u=281  imp:n=1   $ clad
4761  281  -10.2144   -40  59       u=281  imp:n=1  vol=78.9937  $ fuel
4762  4  -1.785E-4   40 -41  59     u=281  imp:n=1   $ gap
4763  2  -6.74       41 -42  59     u=281  imp:n=1   $ clad
4764  281  -10.2144   -43  59       u=281  imp:n=1  vol=78.9937  $ fuel
4765  4  -1.785E-4   43 -44  59     u=281  imp:n=1   $ gap
4766  2  -6.74       44 -45  59     u=281  imp:n=1   $ clad
4767  281  -10.2144   -46  59       u=281  imp:n=1  vol=78.9937  $ fuel
4768  4  -1.785E-4   46 -47  59     u=281  imp:n=1   $ gap
4769  2  -6.74       47 -48  59     u=281  imp:n=1   $ clad
4770  281  -10.2144   -49  59       u=281  imp:n=1  vol=78.9937  $ fuel
4771  4  -1.785E-4   49 -50  59     u=281  imp:n=1   $ gap
4772  2  -6.74       50 -51  59     u=281  imp:n=1   $ clad
4773  281  -10.2144   -52  59       u=281  imp:n=1  vol=78.9937  $ fuel
4774  4  -1.785E-4   52 -53  59     u=281  imp:n=1   $ gap
4775  2  -6.74       53 -54  59     u=281  imp:n=1   $ clad
4776  281  -10.2144   -55  59       u=281  imp:n=1  vol=78.9937  $ fuel
4777  4  -1.785E-4   55 -56  59     u=281  imp:n=1   $ gap
4778  2  -6.74       56 -57  59     u=281  imp:n=1   $ clad
4779  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=281  imp:n=1    $ D2O coolant
4780  3  -0.8143    -59 -60          u=281  imp:n=1    $ spacer
C      ***************************************************************
4781   282  -10.2144   -1  59        u=282  imp:n=1  vol=78.9937  $ fuel
4782   4  -1.785E-4   1 -2  59       u=282  imp:n=1   $ gap
4783   2  -6.74       2 -3  59       u=282  imp:n=1   $ clad
4784   282  -10.2144   -4  59        u=282  imp:n=1  vol=78.9937  $ fuel
```

```
4785   4  -1.785E-4   4 -5  59       u=282  imp:n=1   $ gap
4786   2  -6.74       5 -6  59       u=282  imp:n=1   $ clad
4787   282  -10.2144   -7  59        u=282  imp:n=1  vol=78.9937  $ fuel
4788   4  -1.785E-4   7 -8  59       u=282  imp:n=1   $ gap
4789   2  -6.74       8 -9  59       u=282  imp:n=1   $ clad
4790  282  -10.2144   -10   59      u=282  imp:n=1  vol=78.9937  $ fuel
4791  4  -1.785E-4   10 -11  59     u=282  imp:n=1   $ gap
4792  2  -6.74       11 -12  59     u=282  imp:n=1   $ clad
4793  282  -10.2144   -13  59       u=282  imp:n=1  vol=78.9937  $ fuel
4794  4  -1.785E-4   13 -14  59     u=282  imp:n=1   $ gap
4795  2  -6.74       14 -15  59     u=282  imp:n=1   $ clad
4796  282  -10.2144   -16  59       u=282  imp:n=1  vol=78.9937  $ fuel
4797  4  -1.785E-4   16 -17  59     u=282  imp:n=1   $ gap
4798  2  -6.74       17 -18  59     u=282  imp:n=1   $ clad
4799  282  -10.2144   -19  59       u=282  imp:n=1  vol=78.9937  $ fuel
4800  4  -1.785E-4   19 -20  59     u=282  imp:n=1   $ gap
4801  2  -6.74       20 -21  59     u=282  imp:n=1   $ clad
4802  282  -10.2144   -22  59       u=282  imp:n=1  vol=78.9937  $ fuel
4803  4  -1.785E-4   22 -23  59     u=282  imp:n=1   $ gap
4804  2  -6.74       23 -24  59     u=282  imp:n=1   $ clad
4805  282  -10.2144   -25  59       u=282  imp:n=1  vol=78.9937  $ fuel
4806  4  -1.785E-4   25 -26  59     u=282  imp:n=1   $ gap
4807  2  -6.74       26 -27  59     u=282  imp:n=1   $ clad
4808  282  -10.2144   -28  59       u=282  imp:n=1  vol=78.9937  $ fuel
4809  4  -1.785E-4   28 -29  59     u=282  imp:n=1   $ gap
4810  2  -6.74       29 -30  59     u=282  imp:n=1   $ clad
4811  282  -10.2144   -31  59       u=282  imp:n=1  vol=78.9937  $ fuel
4812  4  -1.785E-4   31 -32  59     u=282  imp:n=1   $ gap
4813  2  -6.74       32 -33  59     u=282  imp:n=1   $ clad
4814  282  -10.2144   -34  59       u=282  imp:n=1  vol=78.9937  $ fuel
4815  4  -1.785E-4   34 -35  59     u=282  imp:n=1   $ gap
4816  2  -6.74       35 -36  59     u=282  imp:n=1   $ clad
4817  282  -10.2144   -37  59       u=282  imp:n=1  vol=78.9937  $ fuel
4818  4  -1.785E-4   37 -38  59     u=282  imp:n=1   $ gap
4819  2  -6.74       38 -39  59     u=282  imp:n=1   $ clad
4820  282  -10.2144   -40  59       u=282  imp:n=1  vol=78.9937  $ fuel
4821  4  -1.785E-4   40 -41  59     u=282  imp:n=1   $ gap
4822  2  -6.74       41 -42  59     u=282  imp:n=1   $ clad
4823  282  -10.2144   -43  59       u=282  imp:n=1  vol=78.9937  $ fuel
4824  4  -1.785E-4   43 -44  59     u=282  imp:n=1   $ gap
4825  2  -6.74       44 -45  59     u=282  imp:n=1   $ clad
4826  282  -10.2144   -46  59       u=282  imp:n=1  vol=78.9937  $ fuel
4827  4  -1.785E-4   46 -47  59     u=282  imp:n=1   $ gap
4828  2  -6.74       47 -48  59     u=282  imp:n=1   $ clad
4829  282  -10.2144   -49  59       u=282  imp:n=1  vol=78.9937  $ fuel
4830  4  -1.785E-4   49 -50  59     u=282  imp:n=1   $ gap
4831  2  -6.74       50 -51  59     u=282  imp:n=1   $ clad
4832  282  -10.2144   -52  59       u=282  imp:n=1  vol=78.9937  $ fuel
4833  4  -1.785E-4   52 -53  59     u=282  imp:n=1   $ gap
4834  2  -6.74       53 -54  59     u=282  imp:n=1   $ clad
4835  282  -10.2144   -55  59       u=282  imp:n=1  vol=78.9937  $ fuel
4836  4  -1.785E-4   55 -56  59     u=282  imp:n=1   $ gap
4837  2  -6.74       56 -57  59     u=282  imp:n=1   $ clad
4838  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=282  imp:n=1    $ D2O coolant
```

```
4839  3  -0.8143    -59 -60           u=282  imp:n=1    $ spacer
C      ************************************************************
4840   284  -10.2144   -1  59        u=284  imp:n=1  vol=78.9937  $ fuel
4841   4  -1.785E-4   1 -2  59       u=284  imp:n=1   $ gap
4842   2  -6.74       2 -3  59       u=284  imp:n=1   $ clad
4843   284  -10.2144   -4  59        u=284  imp:n=1  vol=78.9937  $ fuel
4844   4  -1.785E-4   4 -5  59       u=284  imp:n=1   $ gap
4845   2  -6.74       5 -6  59       u=284  imp:n=1   $ clad
4846   284  -10.2144   -7  59        u=284  imp:n=1  vol=78.9937  $ fuel
4847   4  -1.785E-4   7 -8  59       u=284  imp:n=1   $ gap
4848   2  -6.74       8 -9  59       u=284  imp:n=1   $ clad
4849  284  -10.2144   -10   59      u=284  imp:n=1  vol=78.9937  $ fuel
4850  4  -1.785E-4   10 -11  59     u=284  imp:n=1   $ gap
4851  2  -6.74       11 -12  59     u=284  imp:n=1   $ clad
4852  284  -10.2144   -13  59       u=284  imp:n=1  vol=78.9937  $ fuel
4853  4  -1.785E-4   13 -14  59     u=284  imp:n=1   $ gap
4854  2  -6.74       14 -15  59     u=284  imp:n=1   $ clad
4855  284  -10.2144   -16  59       u=284  imp:n=1  vol=78.9937  $ fuel
4856  4  -1.785E-4   16 -17  59     u=284  imp:n=1   $ gap
4857  2  -6.74       17 -18  59     u=284  imp:n=1   $ clad
4858  284  -10.2144   -19  59       u=284  imp:n=1  vol=78.9937  $ fuel
4859  4  -1.785E-4   19 -20  59     u=284  imp:n=1   $ gap
4860  2  -6.74       20 -21  59     u=284  imp:n=1   $ clad
4861  284  -10.2144   -22  59       u=284  imp:n=1  vol=78.9937  $ fuel
4862  4  -1.785E-4   22 -23  59     u=284  imp:n=1   $ gap
4863  2  -6.74       23 -24  59     u=284  imp:n=1   $ clad
4864  284  -10.2144   -25  59       u=284  imp:n=1  vol=78.9937  $ fuel
4865  4  -1.785E-4   25 -26  59     u=284  imp:n=1   $ gap
4866  2  -6.74       26 -27  59     u=284  imp:n=1   $ clad
4867  284  -10.2144   -28  59       u=284  imp:n=1  vol=78.9937  $ fuel
4868  4  -1.785E-4   28 -29  59     u=284  imp:n=1   $ gap
4869  2  -6.74       29 -30  59     u=284  imp:n=1   $ clad
4870  284  -10.2144   -31  59       u=284  imp:n=1  vol=78.9937  $ fuel
4871  4  -1.785E-4   31 -32  59     u=284  imp:n=1   $ gap
4872  2  -6.74       32 -33  59     u=284  imp:n=1   $ clad
4873  284  -10.2144   -34  59       u=284  imp:n=1  vol=78.9937  $ fuel
4874  4  -1.785E-4   34 -35  59     u=284  imp:n=1   $ gap
4875  2  -6.74       35 -36  59     u=284  imp:n=1   $ clad
4876  284  -10.2144   -37  59       u=284  imp:n=1  vol=78.9937  $ fuel
4877  4  -1.785E-4   37 -38  59     u=284  imp:n=1   $ gap
4878  2  -6.74       38 -39  59     u=284  imp:n=1   $ clad
4879  284  -10.2144   -40  59       u=284  imp:n=1  vol=78.9937  $ fuel
4880  4  -1.785E-4   40 -41  59     u=284  imp:n=1   $ gap
4881  2  -6.74       41 -42  59     u=284  imp:n=1   $ clad
4882  284  -10.2144   -43  59       u=284  imp:n=1  vol=78.9937  $ fuel
4883  4  -1.785E-4   43 -44  59     u=284  imp:n=1   $ gap
4884  2  -6.74       44 -45  59     u=284  imp:n=1   $ clad
4885  284  -10.2144   -46  59       u=284  imp:n=1  vol=78.9937  $ fuel
4886  4  -1.785E-4   46 -47  59     u=284  imp:n=1   $ gap
4887  2  -6.74       47 -48  59     u=284  imp:n=1   $ clad
4888  284  -10.2144   -49  59       u=284  imp:n=1  vol=78.9937  $ fuel
4889  4  -1.785E-4   49 -50  59     u=284  imp:n=1   $ gap
4890  2  -6.74       50 -51  59     u=284  imp:n=1   $ clad
4891  284  -10.2144   -52  59       u=284  imp:n=1  vol=78.9937  $ fuel
4892  4  -1.785E-4   52 -53  59     u=284  imp:n=1   $ gap
```

```
4893  2  -6.74       53 -54  59     u=284  imp:n=1   $ clad
4894  284  -10.2144   -55  59       u=284  imp:n=1  vol=78.9937  $ fuel
4895  4  -1.785E-4   55 -56  59     u=284  imp:n=1   $ gap
4896  2  -6.74       56 -57  59     u=284  imp:n=1   $ clad
4897  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=284  imp:n=1    $ D2O coolant
4898  3  -0.8143    -59 -60          u=284  imp:n=1    $ spacer
C      ************************************************************
4899   291  -10.2144   -1  59        u=291  imp:n=1  vol=78.9937  $ fuel
4900   4  -1.785E-4   1 -2  59       u=291  imp:n=1   $ gap
4901   2  -6.74       2 -3  59       u=291  imp:n=1   $ clad
4902   291  -10.2144   -4  59        u=291  imp:n=1  vol=78.9937  $ fuel
4903   4  -1.785E-4   4 -5  59       u=291  imp:n=1   $ gap
4904   2  -6.74       5 -6  59       u=291  imp:n=1   $ clad
4905   291  -10.2144   -7  59        u=291  imp:n=1  vol=78.9937  $ fuel
4906   4  -1.785E-4   7 -8  59       u=291  imp:n=1   $ gap
4907   2  -6.74       8 -9  59       u=291  imp:n=1   $ clad
4908  291  -10.2144   -10   59      u=291  imp:n=1  vol=78.9937  $ fuel
4909  4  -1.785E-4   10 -11  59     u=291  imp:n=1   $ gap
4910  2  -6.74       11 -12  59     u=291  imp:n=1   $ clad
4911  291  -10.2144   -13  59       u=291  imp:n=1  vol=78.9937  $ fuel
4912  4  -1.785E-4   13 -14  59     u=291  imp:n=1   $ gap
4913  2  -6.74       14 -15  59     u=291  imp:n=1   $ clad
4914  291  -10.2144   -16  59       u=291  imp:n=1  vol=78.9937  $ fuel
4915  4  -1.785E-4   16 -17  59     u=291  imp:n=1   $ gap
4916  2  -6.74       17 -18  59     u=291  imp:n=1   $ clad
4917  291  -10.2144   -19  59       u=291  imp:n=1  vol=78.9937  $ fuel
4918  4  -1.785E-4   19 -20  59     u=291  imp:n=1   $ gap
4919  2  -6.74       20 -21  59     u=291  imp:n=1   $ clad
4920  291  -10.2144   -22  59       u=291  imp:n=1  vol=78.9937  $ fuel
4921  4  -1.785E-4   22 -23  59     u=291  imp:n=1   $ gap
4922  2  -6.74       23 -24  59     u=291  imp:n=1   $ clad
4923  291  -10.2144   -25  59       u=291  imp:n=1  vol=78.9937  $ fuel
4924  4  -1.785E-4   25 -26  59     u=291  imp:n=1   $ gap
4925  2  -6.74       26 -27  59     u=291  imp:n=1   $ clad
4926  291  -10.2144   -28  59       u=291  imp:n=1  vol=78.9937  $ fuel
4927  4  -1.785E-4   28 -29  59     u=291  imp:n=1   $ gap
4928  2  -6.74       29 -30  59     u=291  imp:n=1   $ clad
4929  291  -10.2144   -31  59       u=291  imp:n=1  vol=78.9937  $ fuel
4930  4  -1.785E-4   31 -32  59     u=291  imp:n=1   $ gap
4931  2  -6.74       32 -33  59     u=291  imp:n=1   $ clad
4932  291  -10.2144   -34  59       u=291  imp:n=1  vol=78.9937  $ fuel
4933  4  -1.785E-4   34 -35  59     u=291  imp:n=1   $ gap
4934  2  -6.74       35 -36  59     u=291  imp:n=1   $ clad
4935  291  -10.2144   -37  59       u=291  imp:n=1  vol=78.9937  $ fuel
4936  4  -1.785E-4   37 -38  59     u=291  imp:n=1   $ gap
4937  2  -6.74       38 -39  59     u=291  imp:n=1   $ clad
4938  291  -10.2144   -40  59       u=291  imp:n=1  vol=78.9937  $ fuel
4939  4  -1.785E-4   40 -41  59     u=291  imp:n=1   $ gap
4940  2  -6.74       41 -42  59     u=291  imp:n=1   $ clad
4941  291  -10.2144   -43  59       u=291  imp:n=1  vol=78.9937  $ fuel
4942  4  -1.785E-4   43 -44  59     u=291  imp:n=1   $ gap
4943  2  -6.74       44 -45  59     u=291  imp:n=1   $ clad
4944  291  -10.2144   -46  59       u=291  imp:n=1  vol=78.9937  $ fuel
4945  4  -1.785E-4   46 -47  59     u=291  imp:n=1   $ gap
```

```
4946  2  -6.74       47 -48  59     u=291  imp:n=1   $ clad
4947  291  -10.2144   -49  59       u=291  imp:n=1  vol=78.9937  $ fuel
4948  4  -1.785E-4   49 -50  59     u=291  imp:n=1   $ gap
4949  2  -6.74       50 -51  59     u=291  imp:n=1   $ clad
4950  291  -10.2144   -52  59       u=291  imp:n=1  vol=78.9937  $ fuel
4951  4  -1.785E-4   52 -53  59     u=291  imp:n=1   $ gap
4952  2  -6.74       53 -54  59     u=291  imp:n=1   $ clad
4953  291  -10.2144   -55  59       u=291  imp:n=1  vol=78.9937  $ fuel
4954  4  -1.785E-4   55 -56  59     u=291  imp:n=1   $ gap
4955  2  -6.74       56 -57  59     u=291  imp:n=1   $ clad
4956  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=291  imp:n=1    $ D2O coolant
4957  3  -0.8143    -59 -60          u=291  imp:n=1    $ spacer
C      ************************************************************
4958   292  -10.2144   -1  59        u=292  imp:n=1  vol=78.9937  $ fuel
4959   4  -1.785E-4   1 -2  59       u=292  imp:n=1   $ gap
4960   2  -6.74       2 -3  59       u=292  imp:n=1   $ clad
4961   292  -10.2144   -4  59        u=292  imp:n=1  vol=78.9937  $ fuel
4962   4  -1.785E-4   4 -5  59       u=292  imp:n=1   $ gap
4963   2  -6.74       5 -6  59       u=292  imp:n=1   $ clad
4964   292  -10.2144   -7  59        u=292  imp:n=1  vol=78.9937  $ fuel
4965   4  -1.785E-4   7 -8  59       u=292  imp:n=1   $ gap
4966   2  -6.74       8 -9  59       u=292  imp:n=1   $ clad
4967  292  -10.2144   -10   59      u=292  imp:n=1  vol=78.9937  $ fuel
4968  4  -1.785E-4   10 -11  59     u=292  imp:n=1   $ gap
4969  2  -6.74       11 -12  59     u=292  imp:n=1   $ clad
4970  292  -10.2144   -13  59       u=292  imp:n=1  vol=78.9937  $ fuel
4971  4  -1.785E-4   13 -14  59     u=292  imp:n=1   $ gap
4972  2  -6.74       14 -15  59     u=292  imp:n=1   $ clad
4973  292  -10.2144   -16  59       u=292  imp:n=1  vol=78.9937  $ fuel
4974  4  -1.785E-4   16 -17  59     u=292  imp:n=1   $ gap
4975  2  -6.74       17 -18  59     u=292  imp:n=1   $ clad
4976  292  -10.2144   -19  59       u=292  imp:n=1  vol=78.9937  $ fuel
4977  4  -1.785E-4   19 -20  59     u=292  imp:n=1   $ gap
4978  2  -6.74       20 -21  59     u=292  imp:n=1   $ clad
4979  292  -10.2144   -22  59       u=292  imp:n=1  vol=78.9937  $ fuel
4980  4  -1.785E-4   22 -23  59     u=292  imp:n=1   $ gap
4981  2  -6.74       23 -24  59     u=292  imp:n=1   $ clad
4982  292  -10.2144   -25  59       u=292  imp:n=1  vol=78.9937  $ fuel
4983  4  -1.785E-4   25 -26  59     u=292  imp:n=1   $ gap
4984  2  -6.74       26 -27  59     u=292  imp:n=1   $ clad
4985  292  -10.2144   -28  59       u=292  imp:n=1  vol=78.9937  $ fuel
4986  4  -1.785E-4   28 -29  59     u=292  imp:n=1   $ gap
4987  2  -6.74       29 -30  59     u=292  imp:n=1   $ clad
4988  292  -10.2144   -31  59       u=292  imp:n=1  vol=78.9937  $ fuel
4989  4  -1.785E-4   31 -32  59     u=292  imp:n=1   $ gap
4990  2  -6.74       32 -33  59     u=292  imp:n=1   $ clad
4991  292  -10.2144   -34  59       u=292  imp:n=1  vol=78.9937  $ fuel
4992  4  -1.785E-4   34 -35  59     u=292  imp:n=1   $ gap
4993  2  -6.74       35 -36  59     u=292  imp:n=1   $ clad
4994  292  -10.2144   -37  59       u=292  imp:n=1  vol=78.9937  $ fuel
4995  4  -1.785E-4   37 -38  59     u=292  imp:n=1   $ gap
4996  2  -6.74       38 -39  59     u=292  imp:n=1   $ clad
4997  292  -10.2144   -40  59       u=292  imp:n=1  vol=78.9937  $ fuel
4998  4  -1.785E-4   40 -41  59     u=292  imp:n=1   $ gap
```

```
4999  2  -6.74       41 -42  59     u=292  imp:n=1   $ clad
5000  292  -10.2144   -43  59       u=292  imp:n=1  vol=78.9937  $ fuel
5001  4  -1.785E-4   43 -44  59     u=292  imp:n=1   $ gap
5002  2  -6.74       44 -45  59     u=292  imp:n=1   $ clad
5003  292  -10.2144   -46  59       u=292  imp:n=1  vol=78.9937  $ fuel
5004  4  -1.785E-4   46 -47  59     u=292  imp:n=1   $ gap
5005  2  -6.74       47 -48  59     u=292  imp:n=1   $ clad
5006  292  -10.2144   -49  59       u=292  imp:n=1  vol=78.9937  $ fuel
5007  4  -1.785E-4   49 -50  59     u=292  imp:n=1   $ gap
5008  2  -6.74       50 -51  59     u=292  imp:n=1   $ clad
5009  292  -10.2144   -52  59       u=292  imp:n=1  vol=78.9937  $ fuel
5010  4  -1.785E-4   52 -53  59     u=292  imp:n=1   $ gap
5011  2  -6.74       53 -54  59     u=292  imp:n=1   $ clad
5012  292  -10.2144   -55  59       u=292  imp:n=1  vol=78.9937  $ fuel
5013  4  -1.785E-4   55 -56  59     u=292  imp:n=1   $ gap
5014  2  -6.74       56 -57  59     u=292  imp:n=1   $ clad
5015  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=292  imp:n=1    $ D2O coolant
5016  3  -0.8143    -59 -60          u=292  imp:n=1    $ spacer
C      ************************************************************
5017   294  -10.2144   -1  59        u=294  imp:n=1  vol=78.9937  $ fuel
5018   4  -1.785E-4   1 -2  59       u=294  imp:n=1   $ gap
5019   2  -6.74       2 -3  59       u=294  imp:n=1   $ clad
5020   294  -10.2144   -4  59        u=294  imp:n=1  vol=78.9937  $ fuel
5021   4  -1.785E-4   4 -5  59       u=294  imp:n=1   $ gap
5022   2  -6.74       5 -6  59       u=294  imp:n=1   $ clad
5023   294  -10.2144   -7  59        u=294  imp:n=1  vol=78.9937  $ fuel
5024   4  -1.785E-4   7 -8  59       u=294  imp:n=1   $ gap
5025   2  -6.74       8 -9  59       u=294  imp:n=1   $ clad
5026  294  -10.2144   -10   59      u=294  imp:n=1  vol=78.9937  $ fuel
5027  4  -1.785E-4   10 -11  59     u=294  imp:n=1   $ gap
5028  2  -6.74       11 -12  59     u=294  imp:n=1   $ clad
5029  294  -10.2144   -13  59       u=294  imp:n=1  vol=78.9937  $ fuel
5030  4  -1.785E-4   13 -14  59     u=294  imp:n=1   $ gap
5031  2  -6.74       14 -15  59     u=294  imp:n=1   $ clad
5032  294  -10.2144   -16  59       u=294  imp:n=1  vol=78.9937  $ fuel
5033  4  -1.785E-4   16 -17  59     u=294  imp:n=1   $ gap
5034  2  -6.74       17 -18  59     u=294  imp:n=1   $ clad
5035  294  -10.2144   -19  59       u=294  imp:n=1  vol=78.9937  $ fuel
5036  4  -1.785E-4   19 -20  59     u=294  imp:n=1   $ gap
5037  2  -6.74       20 -21  59     u=294  imp:n=1   $ clad
5038  294  -10.2144   -22  59       u=294  imp:n=1  vol=78.9937  $ fuel
5039  4  -1.785E-4   22 -23  59     u=294  imp:n=1   $ gap
5040  2  -6.74       23 -24  59     u=294  imp:n=1   $ clad
5041  294  -10.2144   -25  59       u=294  imp:n=1  vol=78.9937  $ fuel
5042  4  -1.785E-4   25 -26  59     u=294  imp:n=1   $ gap
5043  2  -6.74       26 -27  59     u=294  imp:n=1   $ clad
5044  294  -10.2144   -28  59       u=294  imp:n=1  vol=78.9937  $ fuel
5045  4  -1.785E-4   28 -29  59     u=294  imp:n=1   $ gap
5046  2  -6.74       29 -30  59     u=294  imp:n=1   $ clad
5047  294  -10.2144   -31  59       u=294  imp:n=1  vol=78.9937  $ fuel
5048  4  -1.785E-4   31 -32  59     u=294  imp:n=1   $ gap
5049  2  -6.74       32 -33  59     u=294  imp:n=1   $ clad
5050  294  -10.2144   -34  59       u=294  imp:n=1  vol=78.9937  $ fuel
5051  4  -1.785E-4   34 -35  59     u=294  imp:n=1   $ gap
```

```
5052  2  -6.74       35 -36  59     u=294  imp:n=1   $ clad
5053  294  -10.2144   -37  59       u=294  imp:n=1  vol=78.9937  $ fuel
5054  4  -1.785E-4   37 -38  59     u=294  imp:n=1   $ gap
5055  2  -6.74       38 -39  59     u=294  imp:n=1   $ clad
5056  294  -10.2144   -40  59       u=294  imp:n=1  vol=78.9937  $ fuel
5057  4  -1.785E-4   40 -41  59     u=294  imp:n=1   $ gap
5058  2  -6.74       41 -42  59     u=294  imp:n=1   $ clad
5059  294  -10.2144   -43  59       u=294  imp:n=1  vol=78.9937  $ fuel
5060  4  -1.785E-4   43 -44  59     u=294  imp:n=1   $ gap
5061  2  -6.74       44 -45  59     u=294  imp:n=1   $ clad
5062  294  -10.2144   -46  59       u=294  imp:n=1  vol=78.9937  $ fuel
5063  4  -1.785E-4   46 -47  59     u=294  imp:n=1   $ gap
5064  2  -6.74       47 -48  59     u=294  imp:n=1   $ clad
5065  294  -10.2144   -49  59       u=294  imp:n=1  vol=78.9937  $ fuel
5066  4  -1.785E-4   49 -50  59     u=294  imp:n=1   $ gap
5067  2  -6.74       50 -51  59     u=294  imp:n=1   $ clad
5068  294  -10.2144   -52  59       u=294  imp:n=1  vol=78.9937  $ fuel
5069  4  -1.785E-4   52 -53  59     u=294  imp:n=1   $ gap
5070  2  -6.74       53 -54  59     u=294  imp:n=1   $ clad
5071  294  -10.2144   -55  59       u=294  imp:n=1  vol=78.9937  $ fuel
5072  4  -1.785E-4   55 -56  59     u=294  imp:n=1   $ gap
5073  2  -6.74       56 -57  59     u=294  imp:n=1   $ clad
5074  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                    (-60 59)     u=294  imp:n=1    $ D2O coolant
5075  3  -0.8143    -59 -60          u=294  imp:n=1    $ spacer
C      ********************************************************************
5076   301  -10.2144   -1  59        u=301  imp:n=1  vol=78.9937  $ fuel
5077   4  -1.785E-4   1 -2  59       u=301  imp:n=1   $ gap
5078   2  -6.74       2 -3  59       u=301  imp:n=1   $ clad
5079   301  -10.2144   -4  59        u=301  imp:n=1  vol=78.9937  $ fuel
5080   4  -1.785E-4   4 -5  59       u=301  imp:n=1   $ gap
5081   2  -6.74       5 -6  59       u=301  imp:n=1   $ clad
5082   301  -10.2144   -7  59        u=301  imp:n=1  vol=78.9937  $ fuel
5083   4  -1.785E-4   7 -8  59       u=301  imp:n=1   $ gap
5084   2  -6.74       8 -9  59       u=301  imp:n=1   $ clad
5085  301  -10.2144   -10   59      u=301  imp:n=1  vol=78.9937  $ fuel
5086  4  -1.785E-4   10 -11  59     u=301  imp:n=1   $ gap
5087  2  -6.74       11 -12  59     u=301  imp:n=1   $ clad
5088  301  -10.2144   -13  59       u=301  imp:n=1  vol=78.9937  $ fuel
5089  4  -1.785E-4   13 -14  59     u=301  imp:n=1   $ gap
5090  2  -6.74       14 -15  59     u=301  imp:n=1   $ clad
5091  301  -10.2144   -16  59       u=301  imp:n=1  vol=78.9937  $ fuel
5092  4  -1.785E-4   16 -17  59     u=301  imp:n=1   $ gap
5093  2  -6.74       17 -18  59     u=301  imp:n=1   $ clad
5094  301  -10.2144   -19  59       u=301  imp:n=1  vol=78.9937  $ fuel
5095  4  -1.785E-4   19 -20  59     u=301  imp:n=1   $ gap
5096  2  -6.74       20 -21  59     u=301  imp:n=1   $ clad
5097  301  -10.2144   -22  59       u=301  imp:n=1  vol=78.9937  $ fuel
5098  4  -1.785E-4   22 -23  59     u=301  imp:n=1   $ gap
5099  2  -6.74       23 -24  59     u=301  imp:n=1   $ clad
5100  301  -10.2144   -25  59       u=301  imp:n=1  vol=78.9937  $ fuel
5101  4  -1.785E-4   25 -26  59     u=301  imp:n=1   $ gap
5102  2  -6.74       26 -27  59     u=301  imp:n=1   $ clad
5103  301  -10.2144   -28  59       u=301  imp:n=1  vol=78.9937  $ fuel
5104  4  -1.785E-4   28 -29  59     u=301  imp:n=1   $ gap
```

```
5105  2  -6.74       29 -30  59     u=301  imp:n=1   $ clad
5106  301  -10.2144   -31  59       u=301  imp:n=1  vol=78.9937  $ fuel
5107  4  -1.785E-4   31 -32  59     u=301  imp:n=1   $ gap
5108  2  -6.74       32 -33  59     u=301  imp:n=1   $ clad
5109  301  -10.2144   -34  59       u=301  imp:n=1  vol=78.9937  $ fuel
5110  4  -1.785E-4   34 -35  59     u=301  imp:n=1   $ gap
5111  2  -6.74       35 -36  59     u=301  imp:n=1   $ clad
5112  301  -10.2144   -37  59       u=301  imp:n=1  vol=78.9937  $ fuel
5113  4  -1.785E-4   37 -38  59     u=301  imp:n=1   $ gap
5114  2  -6.74       38 -39  59     u=301  imp:n=1   $ clad
5115  301  -10.2144   -40  59       u=301  imp:n=1  vol=78.9937  $ fuel
5116  4  -1.785E-4   40 -41  59     u=301  imp:n=1   $ gap
5117  2  -6.74       41 -42  59     u=301  imp:n=1   $ clad
5118  301  -10.2144   -43  59       u=301  imp:n=1  vol=78.9937  $ fuel
5119  4  -1.785E-4   43 -44  59     u=301  imp:n=1   $ gap
5120  2  -6.74       44 -45  59     u=301  imp:n=1   $ clad
5121  301  -10.2144   -46  59       u=301  imp:n=1  vol=78.9937  $ fuel
5122  4  -1.785E-4   46 -47  59     u=301  imp:n=1   $ gap
5123  2  -6.74       47 -48  59     u=301  imp:n=1   $ clad
5124  301  -10.2144   -49  59       u=301  imp:n=1  vol=78.9937  $ fuel
5125  4  -1.785E-4   49 -50  59     u=301  imp:n=1   $ gap
5126  2  -6.74       50 -51  59     u=301  imp:n=1   $ clad
5127  301  -10.2144   -52  59       u=301  imp:n=1  vol=78.9937  $ fuel
5128  4  -1.785E-4   52 -53  59     u=301  imp:n=1   $ gap
5129  2  -6.74       53 -54  59     u=301  imp:n=1   $ clad
5130  301  -10.2144   -55  59       u=301  imp:n=1  vol=78.9937  $ fuel
5131  4  -1.785E-4   55 -56  59     u=301  imp:n=1   $ gap
5132  2  -6.74       56 -57  59     u=301  imp:n=1   $ clad
5133  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=301  imp:n=1    $ D2O coolant
5134  3  -0.8143    -59 -60          u=301  imp:n=1    $ spacer
C      ***************************************************************
5135   302  -10.2144   -1  59        u=302  imp:n=1  vol=78.9937  $ fuel
5136   4  -1.785E-4   1 -2  59       u=302  imp:n=1   $ gap
5137   2  -6.74       2 -3  59       u=302  imp:n=1   $ clad
5138   302  -10.2144   -4  59       u=302  imp:n=1  vol=78.9937  $ fuel
5139   4  -1.785E-4   4 -5  59       u=302  imp:n=1   $ gap
5140   2  -6.74       5 -6  59       u=302  imp:n=1   $ clad
5141   302  -10.2144   -7  59       u=302  imp:n=1  vol=78.9937  $ fuel
5142   4  -1.785E-4   7 -8  59       u=302  imp:n=1   $ gap
5143   2  -6.74       8 -9  59       u=302  imp:n=1   $ clad
5144  302  -10.2144   -10   59      u=302  imp:n=1  vol=78.9937  $ fuel
5145  4  -1.785E-4   10 -11  59     u=302  imp:n=1   $ gap
5146  2  -6.74       11 -12  59     u=302  imp:n=1   $ clad
5147  302  -10.2144   -13  59       u=302  imp:n=1  vol=78.9937  $ fuel
5148  4  -1.785E-4   13 -14  59     u=302  imp:n=1   $ gap
5149  2  -6.74       14 -15  59     u=302  imp:n=1   $ clad
5150  302  -10.2144   -16  59       u=302  imp:n=1  vol=78.9937  $ fuel
5151  4  -1.785E-4   16 -17  59     u=302  imp:n=1   $ gap
5152  2  -6.74       17 -18  59     u=302  imp:n=1   $ clad
5153  302  -10.2144   -19  59       u=302  imp:n=1  vol=78.9937  $ fuel
5154  4  -1.785E-4   19 -20  59     u=302  imp:n=1   $ gap
5155  2  -6.74       20 -21  59     u=302  imp:n=1   $ clad
5156  302  -10.2144   -22  59       u=302  imp:n=1  vol=78.9937  $ fuel
5157  4  -1.785E-4   22 -23  59     u=302  imp:n=1   $ gap
```

```
5158  2  -6.74       23 -24  59     u=302  imp:n=1   $ clad
5159  302  -10.2144   -25  59       u=302  imp:n=1  vol=78.9937  $ fuel
5160 4  -1.785E-4   25 -26  59     u=302  imp:n=1   $ gap
5161  2  -6.74       26 -27  59     u=302  imp:n=1   $ clad
5162  302  -10.2144   -28  59       u=302  imp:n=1  vol=78.9937  $ fuel
5163  4  -1.785E-4   28 -29  59     u=302  imp:n=1   $ gap
5164  2  -6.74       29 -30  59     u=302  imp:n=1   $ clad
5165  302  -10.2144   -31  59       u=302  imp:n=1  vol=78.9937  $ fuel
5166  4  -1.785E-4   31 -32  59     u=302  imp:n=1   $ gap
5167  2  -6.74       32 -33  59     u=302  imp:n=1   $ clad
5168  302  -10.2144   -34  59       u=302  imp:n=1  vol=78.9937  $ fuel
5169  4  -1.785E-4   34 -35  59     u=302  imp:n=1   $ gap
5170  2  -6.74       35 -36  59     u=302  imp:n=1   $ clad
5171  302  -10.2144   -37  59       u=302  imp:n=1  vol=78.9937  $ fuel
5172  4  -1.785E-4   37 -38  59     u=302  imp:n=1   $ gap
5173  2  -6.74       38 -39  59     u=302  imp:n=1   $ clad
5174  302  -10.2144   -40  59       u=302  imp:n=1  vol=78.9937  $ fuel
5175  4  -1.785E-4   40 -41  59     u=302  imp:n=1   $ gap
5176  2  -6.74       41 -42  59     u=302  imp:n=1   $ clad
5177  302  -10.2144   -43  59       u=302  imp:n=1  vol=78.9937  $ fuel
5178  4  -1.785E-4   43 -44  59     u=302  imp:n=1   $ gap
5179  2  -6.74       44 -45  59     u=302  imp:n=1   $ clad
5180  302  -10.2144   -46  59       u=302  imp:n=1  vol=78.9937  $ fuel
5181  4  -1.785E-4   46 -47  59     u=302  imp:n=1   $ gap
5182  2  -6.74       47 -48  59     u=302  imp:n=1   $ clad
5183  302  -10.2144   -49  59       u=302  imp:n=1  vol=78.9937  $ fuel
5184  4  -1.785E-4   49 -50  59     u=302  imp:n=1   $ gap
5185  2  -6.74       50 -51  59     u=302  imp:n=1   $ clad
5186  302  -10.2144   -52  59       u=302  imp:n=1  vol=78.9937  $ fuel
5187  4  -1.785E-4   52 -53  59     u=302  imp:n=1   $ gap
5188  2  -6.74       53 -54  59     u=302  imp:n=1   $ clad
5189  302  -10.2144   -55  59       u=302  imp:n=1  vol=78.9937  $ fuel
5190  4  -1.785E-4   55 -56  59     u=302  imp:n=1   $ gap
5191  2  -6.74       56 -57  59     u=302  imp:n=1   $ clad
5192  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=302  imp:n=1    $ D2O coolant
5193  3  -0.8143    -59 -60          u=302  imp:n=1    $ spacer
C      ************************************************************
5194   304  -10.2144   -1  59        u=304  imp:n=1  vol=78.9937  $ fuel
5195   4  -1.785E-4   1 -2  59       u=304  imp:n=1   $ gap
5196   2  -6.74       2 -3  59       u=304  imp:n=1   $ clad
5197   304  -10.2144   -4  59        u=304  imp:n=1  vol=78.9937  $ fuel
5198   4  -1.785E-4   4 -5  59       u=304  imp:n=1   $ gap
5199   2  -6.74       5 -6  59       u=304  imp:n=1   $ clad
5200   304  -10.2144   -7  59        u=304  imp:n=1  vol=78.9937  $ fuel
5201   4  -1.785E-4   7 -8  59       u=304  imp:n=1   $ gap
5202   2  -6.74       8 -9  59       u=304  imp:n=1   $ clad
5203  304  -10.2144   -10   59      u=304  imp:n=1  vol=78.9937  $ fuel
5204  4  -1.785E-4   10 -11  59     u=304  imp:n=1   $ gap
5205  2  -6.74       11 -12  59     u=304  imp:n=1   $ clad
5206  304  -10.2144   -13  59       u=304  imp:n=1  vol=78.9937  $ fuel
5207  4  -1.785E-4   13 -14  59     u=304  imp:n=1   $ gap
5208  2  -6.74       14 -15  59     u=304  imp:n=1   $ clad
5209  304  -10.2144   -16  59       u=304  imp:n=1  vol=78.9937  $ fuel
5210  4  -1.785E-4   16 -17  59     u=304  imp:n=1   $ gap
```

```
5211  2  -6.74       17 -18  59     u=304  imp:n=1   $ clad
5212  304  -10.2144   -19  59       u=304  imp:n=1  vol=78.9937  $ fuel
5213  4  -1.785E-4   19 -20  59     u=304  imp:n=1   $ gap
5214  2  -6.74       20 -21  59     u=304  imp:n=1   $ clad
5215  304  -10.2144   -22  59       u=304  imp:n=1  vol=78.9937  $ fuel
5216  4  -1.785E-4   22 -23  59     u=304  imp:n=1   $ gap
5217  2  -6.74       23 -24  59     u=304  imp:n=1   $ clad
5218  304  -10.2144   -25  59       u=304  imp:n=1  vol=78.9937  $ fuel
5219  4  -1.785E-4   25 -26  59     u=304  imp:n=1   $ gap
5220  2  -6.74       26 -27  59     u=304  imp:n=1   $ clad
5221  304  -10.2144   -28  59       u=304  imp:n=1  vol=78.9937  $ fuel
5222  4  -1.785E-4   28 -29  59     u=304  imp:n=1   $ gap
5223  2  -6.74       29 -30  59     u=304  imp:n=1   $ clad
5224  304  -10.2144   -31  59       u=304  imp:n=1  vol=78.9937  $ fuel
5225  4  -1.785E-4   31 -32  59     u=304  imp:n=1   $ gap
5226  2  -6.74       32 -33  59     u=304  imp:n=1   $ clad
5227  304  -10.2144   -34  59       u=304  imp:n=1  vol=78.9937  $ fuel
5228  4  -1.785E-4   34 -35  59     u=304  imp:n=1   $ gap
5229  2  -6.74       35 -36  59     u=304  imp:n=1   $ clad
5230  304  -10.2144   -37  59       u=304  imp:n=1  vol=78.9937  $ fuel
5231  4  -1.785E-4   37 -38  59     u=304  imp:n=1   $ gap
5232  2  -6.74       38 -39  59     u=304  imp:n=1   $ clad
5233  304  -10.2144   -40  59       u=304  imp:n=1  vol=78.9937  $ fuel
5234  4  -1.785E-4   40 -41  59     u=304  imp:n=1   $ gap
5235  2  -6.74       41 -42  59     u=304  imp:n=1   $ clad
5236  304  -10.2144   -43  59       u=304  imp:n=1  vol=78.9937  $ fuel
5237  4  -1.785E-4   43 -44  59     u=304  imp:n=1   $ gap
5238  2  -6.74       44 -45  59     u=304  imp:n=1   $ clad
5239  304  -10.2144   -46  59       u=304  imp:n=1  vol=78.9937  $ fuel
5240  4  -1.785E-4   46 -47  59     u=304  imp:n=1   $ gap
5241  2  -6.74       47 -48  59     u=304  imp:n=1   $ clad
5242  304  -10.2144   -49  59       u=304  imp:n=1  vol=78.9937  $ fuel
5243  4  -1.785E-4   49 -50  59     u=304  imp:n=1   $ gap
5244  2  -6.74       50 -51  59     u=304  imp:n=1   $ clad
5245  304  -10.2144   -52  59       u=304  imp:n=1  vol=78.9937  $ fuel
5246  4  -1.785E-4   52 -53  59     u=304  imp:n=1   $ gap
5247  2  -6.74       53 -54  59     u=304  imp:n=1   $ clad
5248  304  -10.2144   -55  59       u=304  imp:n=1  vol=78.9937  $ fuel
5249  4  -1.785E-4   55 -56  59     u=304  imp:n=1   $ gap
5250  2  -6.74       56 -57  59     u=304  imp:n=1   $ clad
5251  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                     (-60 59)     u=304  imp:n=1    $ D2O coolant
5252  3  -0.8143    -59 -60          u=304  imp:n=1    $ spacer
C      ************************************************************
C    Universe 2 is Channel
5253  0     -61 -67 68  fill=10       u=2  imp:n=1    $ channel universe
5254  0     -65 66      lat=1 u=10         imp:n=1
      fill=-5:6 0:0 0:0
      1 1 1 1 1 1 1 1 1 1 1 1
5255  2  -6.74      61 -62           u=2  imp:n=1   $ pressure tube
5256  0             62 -63           u=2  imp:n=1   $ spring gap
5257  2  -6.74      63 -64           u=2  imp:n=1   $ calandria tube
5258  3  -0.8143    -61 67           u=2  imp:n=1   $ PHW coolant outside active
core
```

```
5259  3  -0.8143    -61 -68          u=2  imp:n=1   $ PHW coolant outside active
core
5260  8  -6.536     64 -60  71       u=2  imp:n=1   $ Thermal shield filling
5261  5  -1.1       64 -60 -71 72    u=2  imp:n=1   $ active core HW moderator
filling
5262  8  -6.536     64 -60 -72       u=2  imp:n=1   $ Thermal shield filling
C    Universe 5 is Channel
5263  0     -61 -67 68  fill=12      u=5  imp:n=1    $ channel universe
5264  0     -65 66      lat=1 u=12       imp:n=1
      fill=-5:6 0:0 0:0
      1 1 1 1 1 4 1 1 1 1 1 1
5265  2  -6.74      61 -62           u=5  imp:n=1   $ pressure tube
5266  0             62 -63           u=5  imp:n=1   $ spring gap
5267  2  -6.74      63 -64           u=5  imp:n=1   $ calandria tube
5268  3  -0.8143    -61 67           u=5  imp:n=1   $ PHW coolant outside active
core
5269  3  -0.8143    -61 -68          u=5  imp:n=1   $ PHW coolant outside active
core
5270  8  -6.536     64 -60  71       u=5  imp:n=1   $ Thermal shield filling
5271  5  -1.1       64 -60 -71 72    u=5  imp:n=1   $ active core HW moderator
filling
5272  8  -6.536     64 -60 -72       u=5  imp:n=1   $ Thermal shield filling
C
*********************************************************************************
***
C    Universe 20 is Channel
5273  0     -61 -67 68  fill=23      u=20  imp:n=1    $ channel universe
5274  0     -65 66      lat=1 u=23       imp:n=1
      fill=-5:6 0:0 0:0
      22 22 24 24 21 21 21 21 21 21 21 21
5275  2  -6.74      61 -62           u=20  imp:n=1   $ pressure tube
5276  0             62 -63           u=20  imp:n=1   $ spring gap
5277  2  -6.74      63 -64           u=20  imp:n=1   $ calandria tube
5278  3  -0.8143    -61 67           u=20  imp:n=1   $ PHW coolant outside active
core
5279  3  -0.8143    -61 -68          u=20  imp:n=1   $ PHW coolant outside active
core
5280  8  -6.536     64 -60  71       u=20  imp:n=1   $ Thermal shield filling
5281  5  -1.1       64 -60 -71 72    u=20  imp:n=1   $ active core HW moderator
filling
5282  8  -6.536     64 -60 -72       u=20  imp:n=1   $ Thermal shield filling
C    Universe 30 is Channel
5283  0     -61 -67 68  fill=33      u=30  imp:n=1    $ channel universe
5284  0     -65 66      lat=1 u=33       imp:n=1
      fill=-5:6 0:0 0:0
      32 32 34 34 31 31 31 31 31 31 31 31
5285  2  -6.74      61 -62           u=30  imp:n=1   $ pressure tube
5286  0             62 -63           u=30  imp:n=1   $ spring gap
5287  2  -6.74      63 -64           u=30  imp:n=1   $ calandria tube
5288  3  -0.8143    -61 67           u=30  imp:n=1   $ PHW coolant outside active
core
5289  3  -0.8143    -61 -68          u=30  imp:n=1   $ PHW coolant outside active
core
5290  8  -6.536     64 -60  71       u=30  imp:n=1   $ Thermal shield filling
```

```
5291  5  -1.1       64 -60 -71 72     u=30  imp:n=1   $ active core HW moderator
filling
5292  8  -6.536     64 -60 -72        u=30  imp:n=1   $ Thermal shield filling
C    Universe 40 is Channel
5293  0     -61 -67 68  fill=43       u=40  imp:n=1    $ channel universe
5294  0     -65 66      lat=1 u=43          imp:n=1
      fill=-5:6 0:0 0:0
      42 42 44 44 41 41 41 41 41 41 41 41
5295  2  -6.74      61 -62            u=40  imp:n=1   $ pressure tube
5296  0             62 -63            u=40  imp:n=1   $ spring gap
5297  2  -6.74      63 -64            u=40  imp:n=1   $ calandria tube
5298  3  -0.8143    -61 67            u=40  imp:n=1   $ PHW coolant outside active
core
5299  3  -0.8143    -61 -68           u=40  imp:n=1   $ PHW coolant outside active
core
5300  8  -6.536     64 -60  71        u=40  imp:n=1   $ Thermal shield filling
5301  5  -1.1       64 -60 -71 72     u=40  imp:n=1   $ active core HW moderator
filling
5302  8  -6.536     64 -60 -72        u=40  imp:n=1   $ Thermal shield filling
C    Universe 50 is Channel
5303  0     -61 -67 68  fill=53       u=50  imp:n=1    $ channel universe
5304  0     -65 66      lat=1 u=53          imp:n=1
      fill=-5:6 0:0 0:0
      52 52 54 54 51 51 51 51 51 51 51 51
5305  2  -6.74      61 -62            u=50  imp:n=1   $ pressure tube
5306  0             62 -63            u=50  imp:n=1   $ spring gap
5307  2  -6.74      63 -64            u=50  imp:n=1   $ calandria tube
5308  3  -0.8143    -61 67            u=50  imp:n=1   $ PHW coolant outside active
core
5309  3  -0.8143    -61 -68           u=50  imp:n=1   $ PHW coolant outside active
core
5310  8  -6.536     64 -60  71        u=50  imp:n=1   $ Thermal shield filling
5311  5  -1.1       64 -60 -71 72     u=50  imp:n=1   $ active core HW moderator
filling
5312  8  -6.536     64 -60 -72        u=50  imp:n=1   $ Thermal shield filling
C    Universe 60 is Channel
5313  0     -61 -67 68  fill=63       u=60  imp:n=1    $ channel universe
5314  0     -65 66      lat=1 u=63         imp:n=1
      fill=-5:6 0:0 0:0
      62 62 64 64 61 61 61 61 61 61 61 61
5315  2  -6.74      61 -62            u=60  imp:n=1   $ pressure tube
5316  0             62 -63           u=60  imp:n=1   $ spring gap
5317  2  -6.74      63 -64            u=60  imp:n=1   $ calandria tube
5318  3  -0.8143    -61 67            u=60  imp:n=1   $ PHW coolant outside active
core
5319  3  -0.8143    -61 -68           u=60  imp:n=1   $ PHW coolant outside active
core
5320  8  -6.536     64 -60  71        u=60  imp:n=1   $ Thermal shield filling
5321  5  -1.1       64 -60 -71 72     u=60  imp:n=1   $ active core HW moderator
filling
5322  8  -6.536     64 -60 -72        u=60  imp:n=1   $ Thermal shield filling
C    Universe 70 is Channel
5323  0     -61 -67 68  fill=73       u=70  imp:n=1    $ channel universe
5324  0     -65 66      lat=1 u=73         imp:n=1
      fill=-5:6 0:0 0:0
```

```
      72 72 74 74 71 71 71 71 71 71 71 71
5325  2  -6.74      61 -62            u=70  imp:n=1   $ pressure tube
5326  0             62 -63            u=70  imp:n=1   $ spring gap
5327  2  -6.74      63 -64            u=70  imp:n=1   $ calandria tube
5328  3  -0.8143    -61 67            u=70  imp:n=1   $ PHW coolant outside active
core
5329  3  -0.8143    -61 -68           u=70  imp:n=1   $ PHW coolant outside active
core
5330  8  -6.536     64 -60  71        u=70  imp:n=1   $ Thermal shield filling
5331  5  -1.1       64 -60 -71 72     u=70  imp:n=1   $ active core HW moderator
filling
5332  8  -6.536     64 -60 -72        u=70  imp:n=1   $ Thermal shield filling
C    Universe 80 is Channel
5333  0     -61 -67 68  fill=83       u=80  imp:n=1    $ channel universe
5334  0     -65 66      lat=1 u=83         imp:n=1
      fill=-5:6 0:0 0:0
      82 82 84 84 81 81 81 81 81 81 81 81
5335  2  -6.74      61 -62            u=80  imp:n=1   $ pressure tube
5336  0             62 -63            u=80  imp:n=1   $ spring gap
5337  2  -6.74      63 -64            u=80  imp:n=1   $ calandria tube
5338  3  -0.8143    -61 67            u=80  imp:n=1   $ PHW coolant outside active
core
5339  3  -0.8143    -61 -68           u=80  imp:n=1   $ PHW coolant outside active
core
5340  8  -6.536     64 -60  71        u=80  imp:n=1   $ Thermal shield filling
5341  5  -1.1       64 -60 -71 72     u=80  imp:n=1   $ active core HW moderator
filling
5342  8  -6.536     64 -60 -72        u=80  imp:n=1   $ Thermal shield filling
C    Universe 90 is Channel
5343  0     -61 -67 68  fill=93       u=90  imp:n=1    $ channel universe
5344  0     -65 66      lat=1 u=93         imp:n=1
      fill=-5:6 0:0 0:0
      92 92 94 94 91 91 91 91 91 91 91 91
5345  2  -6.74      61 -62            u=90  imp:n=1   $ pressure tube
5346  0             62 -63            u=90  imp:n=1   $ spring gap
5347  2  -6.74      63 -64            u=90  imp:n=1   $ calandria tube
5348  3  -0.8143    -61 67            u=90  imp:n=1   $ PHW coolant outside active
core
5349  3  -0.8143    -61 -68           u=90  imp:n=1   $ PHW coolant outside active
core
5350  8  -6.536     64 -60  71        u=90  imp:n=1   $ Thermal shield filling
5351  5  -1.1       64 -60 -71 72     u=90  imp:n=1   $ active core HW moderator
filling
5352  8  -6.536     64 -60 -72        u=90  imp:n=1   $ Thermal shield filling
C    Universe 100 is Channel
5353  0     -61 -67 68  fill=103      u=100  imp:n=1    $ channel universe
5354  0     -65 66      lat=1 u=103        imp:n=1
      fill=-5:6 0:0 0:0
      102 102 104 104 101 101 101 101 101 101 101 101
5355  2  -6.74      61 -62            u=100  imp:n=1   $ pressure tube
5356  0             62 -63            u=100  imp:n=1   $ spring gap
5357  2  -6.74      63 -64           u=100  imp:n=1   $ calandria tube
5358  3  -0.8143    -61 67            u=100  imp:n=1   $ PHW coolant outside
active core
```

```
5359  3  -0.8143    -61 -68           u=100  imp:n=1   $ PHW coolant outside
active core
5360  8  -6.536     64 -60  71        u=100  imp:n=1   $ Thermal shield filling
5361  5  -1.1       64 -60 -71 72     u=100  imp:n=1   $ active core HW moderator
filling
5362  8  -6.536     64 -60 -72        u=100  imp:n=1   $ Thermal shield filling
C    Universe 110 is Channel
5363  0     -61 -67 68  fill=113      u=110  imp:n=1    $ channel universe
5364  0     -65 66      lat=1 u=113         imp:n=1
      fill=-5:6 0:0 0:0
      112 112 114 114 111 111 111 111 111 111 111 111
5365  2  -6.74      61 -62            u=110  imp:n=1   $ pressure tube
5366  0             62 -63            u=110  imp:n=1   $ spring gap
5367  2  -6.74      63 -64            u=110  imp:n=1   $ calandria tube
5368  3  -0.8143    -61 67            u=110  imp:n=1   $ PHW coolant outside
active core
5369  3  -0.8143    -61 -68           u=110  imp:n=1   $ PHW coolant outside
active core
5370  8  -6.536     64 -60  71        u=110  imp:n=1   $ Thermal shield filling
5371  5  -1.1       64 -60 -71 72     u=110  imp:n=1   $ active core HW moderator
filling
5372  8  -6.536     64 -60 -72        u=110  imp:n=1   $ Thermal shield filling
C    Universe 120 is Channel
5373  0     -61 -67 68  fill=123      u=120  imp:n=1    $ channel universe
5374  0     -65 66      lat=1 u=123         imp:n=1
      fill=-5:6 0:0 0:0
      122 122 124 124 121 121 121 121 121 121 121 121
5375  2  -6.74      61 -62            u=120  imp:n=1   $ pressure tube
5376  0             62 -63            u=120  imp:n=1   $ spring gap
5377  2  -6.74      63 -64            u=120  imp:n=1   $ calandria tube
5378  3  -0.8143    -61 67            u=120  imp:n=1   $ PHW coolant outside
active core
5379  3  -0.8143    -61 -68           u=120  imp:n=1   $ PHW coolant outside
active core
5380  8  -6.536     64 -60  71        u=120  imp:n=1   $ Thermal shield filling
5381  5  -1.1       64 -60 -71 72     u=120  imp:n=1   $ active core HW moderator
filling
5382  8  -6.536     64 -60 -72        u=120  imp:n=1   $ Thermal shield filling
C    Universe 130 is Channel
5383  0     -61 -67 68  fill=133      u=130  imp:n=1    $ channel universe
5384  0     -65 66      lat=1 u=133         imp:n=1
      fill=-5:6 0:0 0:0
      132 132 134 134 131 131 131 131 131 131 131 131
5385  2  -6.74      61 -62            u=130  imp:n=1   $ pressure tube
5386  0             62 -63            u=130  imp:n=1   $ spring gap
5387  2  -6.74      63 -64            u=130  imp:n=1   $ calandria tube
5388  3  -0.8143    -61 67            u=130  imp:n=1   $ PHW coolant outside
active core
5389  3  -0.8143    -61 -68           u=130  imp:n=1   $ PHW coolant outside
active core
5390  8  -6.536     64 -60  71        u=130  imp:n=1   $ Thermal shield filling
5391  5  -1.1       64 -60 -71 72     u=130  imp:n=1   $ active core HW moderator
filling
5392  8  -6.536     64 -60 -72        u=130  imp:n=1   $ Thermal shield filling
C    Universe 140 is Channel
```

```
5393  0     -61 -67 68  fill=143      u=140  imp:n=1    $ channel universe
5394  0     -65 66      lat=1 u=143         imp:n=1
      fill=-5:6 0:0 0:0
      142 142 144 144 141 141 141 141 141 141 141 141
5395  2  -6.74      61 -62            u=140  imp:n=1   $ pressure tube
5396  0             62 -63            u=140  imp:n=1   $ spring gap
5397  2  -6.74      63 -64            u=140  imp:n=1   $ calandria tube
5398  3  -0.8143    -61 67            u=140  imp:n=1   $ PHW coolant outside
active core
5399  3  -0.8143    -61 -68           u=140  imp:n=1   $ PHW coolant outside
active core
5400  8  -6.536     64 -60  71        u=140  imp:n=1   $ Thermal shield filling
5401  5  -1.1       64 -60 -71 72     u=140  imp:n=1   $ active core HW moderator
filling
5402  8  -6.536     64 -60 -72        u=140  imp:n=1   $ Thermal shield filling
C    Universe 150 is Channel
5403  0     -61 -67 68  fill=153      u=150  imp:n=1    $ channel universe
5404  0     -65 66      lat=1 u=153         imp:n=1
      fill=-5:6 0:0 0:0
      152 152 154 154 151 151 151 151 151 151 151 151
5405  2  -6.74      61 -62            u=150  imp:n=1   $ pressure tube
5406  0             62 -63            u=150  imp:n=1   $ spring gap
5407  2  -6.74      63 -64            u=150  imp:n=1   $ calandria tube
5408  3  -0.8143    -61 67            u=150  imp:n=1   $ PHW coolant outside
active core
5409  3  -0.8143    -61 -68           u=150  imp:n=1   $ PHW coolant outside
active core
5410  8  -6.536     64 -60  71        u=150  imp:n=1   $ Thermal shield filling
5411  5  -1.1       64 -60 -71 72     u=150  imp:n=1   $ active core HW moderator
filling
5412  8  -6.536     64 -60 -72        u=150  imp:n=1   $ Thermal shield filling
C    Universe 160 is Channel
5413  0     -61 -67 68  fill=163     u=160  imp:n=1    $ channel universe
5414  0     -65 66      lat=1 u=163         imp:n=1
      fill=-5:6 0:0 0:0
      162 162 164 164 161 161 161 161 161 161 161 161
5415  2  -6.74      61 -62            u=160  imp:n=1   $ pressure tube
5416  0             62 -63            u=160  imp:n=1   $ spring gap
5417  2  -6.74      63 -64            u=160  imp:n=1   $ calandria tube
5418  3  -0.8143    -61 67            u=160  imp:n=1   $ PHW coolant outside
active core
5419  3  -0.8143    -61 -68           u=160  imp:n=1   $ PHW coolant outside
active core
5420  8  -6.536     64 -60  71        u=160  imp:n=1   $ Thermal shield filling
5421  5  -1.1       64 -60 -71 72     u=160  imp:n=1   $ active core HW moderator
filling
5422  8  -6.536     64 -60 -72        u=160  imp:n=1   $ Thermal shield filling
C    Universe 170 is Channel
5423  0     -61 -67 68  fill=173     u=170  imp:n=1    $ channel universe
5424  0     -65 66      lat=1 u=173         imp:n=1
      fill=-5:6 0:0 0:0
      172 172 174 174 171 171 171 171 171 171 171 171
5425  2  -6.74      61 -62            u=170  imp:n=1   $ pressure tube
5426  0             62 -63            u=170  imp:n=1   $ spring gap
5427  2  -6.74      63 -64            u=170  imp:n=1   $ calandria tube
```

```
5428  3  -0.8143    -61 67           u=170  imp:n=1   $ PHW coolant outside
active core
5429  3  -0.8143    -61 -68          u=170  imp:n=1   $ PHW coolant outside
active core
5430  8  -6.536     64 -60  71       u=170  imp:n=1   $ Thermal shield filling
5431  5  -1.1       64 -60 -71 72    u=170  imp:n=1   $ active core HW moderator
filling
5432  8  -6.536     64 -60 -72       u=170  imp:n=1   $ Thermal shield filling
C    Universe 180 is Channel
5433  0     -61 -67 68  fill=183     u=180  imp:n=1    $ channel universe
5434  0     -65 66      lat=1 u=183         imp:n=1
      fill=-5:6 0:0 0:0
      182 182 184 184 181 181 181 181 181 181 181 181
5435  2  -6.74      61 -62           u=180  imp:n=1   $ pressure tube
5436  0             62 -63           u=180  imp:n=1   $ spring gap
5437  2  -6.74      63 -64           u=180  imp:n=1   $ calandria tube
5438  3  -0.8143    -61 67           u=180  imp:n=1   $ PHW coolant outside
active core
5439  3  -0.8143    -61 -68          u=180  imp:n=1   $ PHW coolant outside
active core
5440  8  -6.536     64 -60  71       u=180  imp:n=1   $ Thermal shield filling
5441  5  -1.1       64 -60 -71 72    u=180  imp:n=1   $ active core HW moderator
filling
5442  8  -6.536     64 -60 -72       u=180  imp:n=1   $ Thermal shield filling
C    Universe 190 is Channel
5443  0     -61 -67 68  fill=193     u=190  imp:n=1    $ channel universe
5444  0     -65 66      lat=1 u=193         imp:n=1
      fill=-5:6 0:0 0:0
      192 192 194 194 191 191 191 191 191 191 191 191
5445  2  -6.74      61 -62           u=190  imp:n=1   $ pressure tube
5446  0             62 -63           u=190  imp:n=1   $ spring gap
5447  2  -6.74      63 -64           u=190  imp:n=1   $ calandria tube
5448  3  -0.8143    -61 67           u=190  imp:n=1   $ PHW coolant outside
active core
5449  3  -0.8143    -61 -68          u=190  imp:n=1   $ PHW coolant outside
active core
5450  8  -6.536     64 -60  71       u=190  imp:n=1   $ Thermal shield filling
5451  5  -1.1       64 -60 -71 72    u=190  imp:n=1   $ active core HW moderator
filling
5452  8  -6.536     64 -60 -72       u=190  imp:n=1   $ Thermal shield filling
C    Universe 200 is Channel
5453  0     -61 -67 68  fill=203     u=200  imp:n=1    $ channel universe
5454  0     -65 66      lat=1 u=203         imp:n=1
      fill=-5:6 0:0 0:0
      202 202 204 204 201 201 201 201 201 201 201 201
5455  2  -6.74      61 -62           u=200  imp:n=1   $ pressure tube
5456  0             62 -63           u=200  imp:n=1   $ spring gap
5457  2  -6.74      63 -64           u=200  imp:n=1   $ calandria tube
5458  3  -0.8143    -61 67           u=200  imp:n=1   $ PHW coolant outside
active core
5459  3  -0.8143    -61 -68          u=200  imp:n=1   $ PHW coolant outside
active core
5460  8  -6.536     64 -60  71       u=200  imp:n=1   $ Thermal shield filling
5461  5  -1.1       64 -60 -71 72    u=200  imp:n=1   $ active core HW moderator
filling
```

```
5462  8  -6.536     64 -60 -72        u=200  imp:n=1   $ Thermal shield filling
C    Universe 210 is Channel
5463  0     -61 -67 68  fill=213     u=210  imp:n=1    $ channel universe
5464  0     -65 66      lat=1 u=213         imp:n=1
      fill=-5:6 0:0 0:0
      212 212 214 214 211 211 211 211 211 211 211 211
5465  2  -6.74      61 -62            u=210  imp:n=1   $ pressure tube
5466  0             62 -63            u=210  imp:n=1   $ spring gap
5467  2  -6.74      63 -64            u=210  imp:n=1   $ calandria tube
5468  3  -0.8143    -61 67            u=210  imp:n=1   $ PHW coolant outside
active core
5469  3  -0.8143    -61 -68           u=210  imp:n=1   $ PHW coolant outside
active core
5470  8  -6.536     64 -60  71        u=210  imp:n=1   $ Thermal shield filling
5471  5  -1.1       64 -60 -71 72     u=210  imp:n=1   $ active core HW moderator
filling
5472  8  -6.536     64 -60 -72        u=210  imp:n=1   $ Thermal shield filling
C    Universe 220 is Channel
5473  0     -61 -67 68  fill=223     u=220  imp:n=1    $ channel universe
5474  0     -65 66      lat=1 u=223         imp:n=1
      fill=-5:6 0:0 0:0
      222 222 224 224 221 221 221 221 221 221 221 221
5475  2  -6.74      61 -62            u=220  imp:n=1   $ pressure tube
5476  0             62 -63            u=220  imp:n=1   $ spring gap
5477  2  -6.74      63 -64            u=220  imp:n=1   $ calandria tube
5478  3  -0.8143    -61 67            u=220  imp:n=1   $ PHW coolant outside
active core
5479  3  -0.8143    -61 -68           u=220  imp:n=1   $ PHW coolant outside
active core
5480  8  -6.536     64 -60  71        u=220  imp:n=1   $ Thermal shield filling
5481  5  -1.1       64 -60 -71 72     u=220  imp:n=1   $ active core HW moderator
filling
5482  8  -6.536     64 -60 -72        u=220  imp:n=1   $ Thermal shield filling
C    Universe 230 is Channel
5483  0     -61 -67 68  fill=233     u=230  imp:n=1    $ channel universe
5484  0     -65 66      lat=1 u=233         imp:n=1
      fill=-5:6 0:0 0:0
      232 232 234 234 231 231 231 231 231 231 231 231
5485  2  -6.74      61 -62            u=230  imp:n=1   $ pressure tube
5486  0             62 -63            u=230  imp:n=1   $ spring gap
5487  2  -6.74      63 -64            u=230  imp:n=1   $ calandria tube
5488  3  -0.8143    -61 67            u=230  imp:n=1   $ PHW coolant outside
active core
5489  3  -0.8143    -61 -68           u=230  imp:n=1   $ PHW coolant outside
active core
5490  8  -6.536     64 -60  71        u=230  imp:n=1   $ Thermal shield filling
5491  5  -1.1       64 -60 -71 72     u=230  imp:n=1   $ active core HW moderator
filling
5492  8  -6.536     64 -60 -72        u=230  imp:n=1   $ Thermal shield filling
C    Universe 240 is Channel
5493  0     -61 -67 68  fill=243     u=240  imp:n=1    $ channel universe
5494  0     -65 66      lat=1 u=243         imp:n=1
      fill=-5:6 0:0 0:0
      242 242 244 244 241 241 241 241 241 241 241 241
5495  2  -6.74      61 -62            u=240  imp:n=1   $ pressure tube
```

```
5496  0             62 -63            u=240  imp:n=1   $ spring gap
5497  2  -6.74      63 -64            u=240  imp:n=1   $ calandria tube
5498  3  -0.8143    -61 67            u=240  imp:n=1   $ PHW coolant outside
active core
5499  3  -0.8143    -61 -68           u=240  imp:n=1   $ PHW coolant outside
active core
5500  8  -6.536     64 -60  71        u=240  imp:n=1   $ Thermal shield filling
5501  5  -1.1       64 -60 -71 72     u=240  imp:n=1   $ active core HW moderator
filling
5502  8  -6.536     64 -60 -72        u=240  imp:n=1   $ Thermal shield filling
C    Universe 250 is Channel
5503  0     -61 -67 68  fill=253     u=250  imp:n=1    $ channel universe
5504  0     -65 66      lat=1 u=253         imp:n=1
      fill=-5:6 0:0 0:0
      252 252 254 254 251 251 251 251 251 251 251 251
5505  2  -6.74      61 -62            u=250  imp:n=1   $ pressure tube
5506  0             62 -63            u=250  imp:n=1   $ spring gap
5507  2  -6.74      63 -64            u=250  imp:n=1   $ calandria tube
5508  3  -0.8143    -61 67            u=250  imp:n=1   $ PHW coolant outside
active core
5509  3  -0.8143    -61 -68           u=250  imp:n=1   $ PHW coolant outside
active core
5510  8  -6.536     64 -60  71        u=250  imp:n=1   $ Thermal shield filling
5511  5  -1.1       64 -60 -71 72     u=250  imp:n=1   $ active core HW moderator
filling
5512  8  -6.536     64 -60 -72        u=250  imp:n=1   $ Thermal shield filling
C    Universe 260 is Channel
5513  0     -61 -67 68  fill=263     u=260  imp:n=1    $ channel universe
5514  0     -65 66      lat=1 u=263         imp:n=1
      fill=-5:6 0:0 0:0
      262 262 264 264 261 261 261 261 261 261 261 261
5515  2  -6.74      61 -62            u=260  imp:n=1   $ pressure tube
5516  0             62 -63            u=260  imp:n=1   $ spring gap
5517  2  -6.74      63 -64            u=260  imp:n=1   $ calandria tube
5518  3  -0.8143    -61 67            u=260  imp:n=1   $ PHW coolant outside
active core
5519  3  -0.8143    -61 -68           u=260  imp:n=1   $ PHW coolant outside
active core
5520  8  -6.536     64 -60  71        u=260  imp:n=1   $ Thermal shield filling
5521  5  -1.1       64 -60 -71 72     u=260  imp:n=1   $ active core HW moderator
filling
5522  8  -6.536     64 -60 -72        u=260  imp:n=1   $ Thermal shield filling
C    Universe 270 is Channel
5523  0     -61 -67 68  fill=273     u=270  imp:n=1    $ channel universe
5524  0     -65 66      lat=1 u=273         imp:n=1
      fill=-5:6 0:0 0:0
      272 272 274 274 271 271 271 271 271 271 271 271
5525  2  -6.74      61 -62            u=270  imp:n=1   $ pressure tube
5526  0             62 -63            u=270  imp:n=1   $ spring gap
5527  2  -6.74      63 -64            u=270  imp:n=1   $ calandria tube
5528  3  -0.8143    -61 67            u=270  imp:n=1   $ PHW coolant outside
active core
5529  3  -0.8143    -61 -68           u=270  imp:n=1   $ PHW coolant outside
active core
5530  8  -6.536     64 -60  71        u=270  imp:n=1   $ Thermal shield filling
```

```
5531  5  -1.1       64 -60 -71 72     u=270  imp:n=1   $ active core HW moderator
filling
5532  8  -6.536     64 -60 -72        u=270  imp:n=1   $ Thermal shield filling
C    Universe 280 is Channel
5533  0     -61 -67 68  fill=283      u=280  imp:n=1    $ channel universe
5534  0     -65 66      lat=1 u=283         imp:n=1
      fill=-5:6 0:0 0:0
      282 282 284 284 281 281 281 281 281 281 281 281
5535  2  -6.74      61 -62            u=280  imp:n=1   $ pressure tube
5536  0             62 -63            u=280  imp:n=1   $ spring gap
5537  2  -6.74      63 -64            u=280  imp:n=1   $ calandria tube
5538  3  -0.8143    -61 67            u=280  imp:n=1   $ PHW coolant outside
active core
5539  3  -0.8143    -61 -68           u=280  imp:n=1   $ PHW coolant outside
active core
5540  8  -6.536     64 -60  71        u=280  imp:n=1   $ Thermal shield filling
5541  5  -1.1       64 -60 -71 72     u=280  imp:n=1   $ active core HW moderator
filling
5542  8  -6.536     64 -60 -72        u=280  imp:n=1   $ Thermal shield filling
C    Universe 290 is Channel
5543  0     -61 -67 68  fill=293      u=290  imp:n=1    $ channel universe
5544  0     -65 66      lat=1 u=293         imp:n=1
      fill=-5:6 0:0 0:0
      292 292 294 294 291 291 291 291 291 291 291 291
5545  2  -6.74      61 -62            u=290  imp:n=1   $ pressure tube
5546  0             62 -63            u=290  imp:n=1   $ spring gap
5547  2  -6.74      63 -64            u=290  imp:n=1   $ calandria tube
5548  3  -0.8143    -61 67            u=290  imp:n=1   $ PHW coolant outside
active core
5549  3  -0.8143    -61 -68           u=290  imp:n=1   $ PHW coolant outside
active core
5550  8  -6.536     64 -60  71        u=290  imp:n=1   $ Thermal shield filling
5551  5  -1.1       64 -60 -71 72     u=290  imp:n=1   $ active core HW moderator
filling
5552  8  -6.536     64 -60 -72        u=290  imp:n=1   $ Thermal shield filling
C    Universe 300 is Channel
5553  0     -61 -67 68  fill=303      u=300  imp:n=1    $ channel universe
5554  0     -65 66      lat=1 u=303         imp:n=1
      fill=-5:6 0:0 0:0
      302 302 304 304 301 301 301 301 301 301 301 301
5555  2  -6.74      61 -62            u=300  imp:n=1   $ pressure tube
5556  0             62 -63            u=300  imp:n=1   $ spring gap
5557  2  -6.74      63 -64            u=300  imp:n=1   $ calandria tube
5558  3  -0.8143    -61 67            u=300  imp:n=1   $ PHW coolant outside
active core
5559  3  -0.8143    -61 -68           u=300  imp:n=1   $ PHW coolant outside
active core
5560  8  -6.536     64 -60  71        u=300  imp:n=1   $ Thermal shield filling
5561  5  -1.1       64 -60 -71 72     u=300  imp:n=1   $ active core HW moderator
filling
5562  8  -6.536     64 -60 -72        u=300  imp:n=1   $ Thermal shield filling
C ********************************************************************************
C    Universe 3 is moderator filled channel
5563  8  -6.536     -60  71           u=3  imp:n=1   $ Thermal shield filling
```

```
5564  5  -1.1       -60 -71 72        u=3  imp:n=1   $ active core HW moderator
filling
5565  8  -6.536     -60 -72           u=3  imp:n=1   $ Thermal shield filling
C    Core
5566  0      -69 -73 74  fill=11           imp:n=1   $ core inner
5567  0      -75 76 77 -78  lat=1 u=11 imp:n=1
       fill=-14:14 -14:14 0:0
       3 28R
       3 28R
       3 28R
       3 28R
       3 28R
       3 10R                 2 2 2 2 2 2                              3 11R
       3 8R               2 2 2 2 2 2 2 2 2 2 2                       3 9R
       3 6R           2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                   3 7R
       3 5R         2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                 3 6R
       3 5R         2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                 3 6R
       3 4R       2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2               3 5R
       3 4R       2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2               3 5R
       3 3R     2 2 2 2 2 2 2 2 20 30 40 50 60 70 80 2 2 2 2 2        3 4R
       3 3R     2 2 2 2 2 2 2 2 90 100 110 120 130 140 2 2 2 2 2 2    3 4R
       3 3R     2 2 2 2 2 2 2 2 150 160 5 170 180 2 2 2 2 2 2 2       3 4R
       3 3R     2 2 2 2 2 2 2 2 240 230 220 210 200 190 2 2 2 2 2 2   3 4R
       3 3R     2 2 2 2 2 2 2 2 300 290 280 270 260 250 2 2 2 2 2 2   3 4R
       3 4R       2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                 3 5R
       3 4R       2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                 3 5R
       3 4R       2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                 3 5R
       3 5R         2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                   3 6R
       3 5R         2 2 2 2 2 2 2 2 2 2 2 2 2 2 2 2                   3 6R
       3 7R             2 2 2 2 2 2 2 2 2 2 2 2                       3 8R
       3 8R               2 2 2 2 2 2 2 2 2 2                         3 9R
       3 28R
       3 28R
       3 28R
       3 28R
       3 28R
5568  6  -7.92      69 -70 -73 74          imp:n=1   $ calandria shell
5569  0 70:73:-74 imp:n=0

c ** Surface Cards **
1    cx   0.72                        $ fuel radius    -- center pin
2    cx   0.722                       $ clad inner rad -- center pin
3    cx   0.76                        $ clad outer rad -- center pin
4    c/x  0 1.65 0.72                 $ first ring pins...
5    c/x  0 1.65 0.722
6    c/x  0 1.65 0.76
7    c/x  1.42894 0.825 0.72
8    c/x  1.42894 0.825 0.722
9    c/x  1.42894 0.825 0.76
10   c/x  1.42894 -0.825 0.72
11   c/x  1.42894 -0.825 0.722
12   c/x  1.42894 -0.825 0.76
13   c/x  0 -1.65 0.72
14   c/x  0 -1.65 0.722
15   c/x  0 -1.65 0.76
```

```
c/x  -1.42894 -0.825 0.72
c/x  -1.42894 -0.825 0.722
c/x  -1.42894 -0.825 0.76
c/x  -1.42894 0.825 0.72
c/x  -1.42894 0.825 0.722
c/x  -1.42894 0.825 0.76          $ ... first ring pins
c/x  3.07164 0.823045 0.72        $ second ring pins...
c/x  3.07164 0.823045 0.722
c/x  3.07164 0.823045 0.76
c/x  2.2486 2.2486 0.72
c/x  2.2486 2.2486 0.722
c/x  2.2486 2.2486 0.76
c/x  0.823045 3.07164 0.72
c/x  0.823045 3.07164 0.722
c/x  0.823045 3.07164 0.76
c/x  -0.823045 3.07164 0.72
c/x  -0.823045 3.07164 0.722
c/x  -0.823045 3.07164 0.76
c/x  -2.2486 2.2486 0.72
c/x  -2.2486 2.2486 0.722
c/x  -2.2486 2.2486 0.76
c/x  -3.07164 0.823045 0.72
c/x  -3.07164 0.823045 0.722
c/x  -3.07164 0.823045 0.76
c/x  -3.07164 -0.823045 0.72
c/x  -3.07164 -0.823045 0.722
c/x  -3.07164 -0.823045 0.76
c/x  -2.2486 -2.2486 0.72
c/x  -2.2486 -2.2486 0.722
c/x  -2.2486 -2.2486 0.76
c/x  -0.823045 -3.07164 0.72
c/x  -0.823045 -3.07164 0.722
c/x  -0.823045 -3.07164 0.76
c/x  0.823045 -3.07164 0.72
c/x  0.823045 -3.07164 0.722
c/x  0.823045 -3.07164 0.76
c/x  2.2486 -2.2486 0.72
c/x  2.2486 -2.2486 0.722
c/x  2.2486 -2.2486 0.76
c/x  3.07164 -0.823045 0.72
c/x  3.07164 -0.823045 0.722
c/x  3.07164 -0.823045 0.76       $ ... second ring pins
px   0                            $ front of bundle
px   -48.504                      $ rear of bundle
cx   25                           $ dumby PHT
cx   4.13                         $ pressure tube inner radius
cx   4.55                         $ pressure tube outer radius
cx   5.4                          $ calandria tube inner radius
cx   5.55                         $ calandria tube outer radius
px   0                            $ spacer
px   -49.53                       $ spacer
px   297.18                       $ front of channel
px   -297.18                      $ back of channel
c/x  -11.43 0 300                 $ calandria shell inner radius
c/x  -11.43 0 305                 $ calandria shell outer radius
```

```
71   px   251.153                      $ front of active core
72   px   -250.127                     $ back of active core
73   px   322.18                       $ front of thermal shield
74   px   -321.154                     $ back of thermal shield
C ******************************************************************
C for the core latice grid
75  py    11.43
76  py   -11.43
77  pz   -11.43
78  pz    11.43

c ** Data Cards **
kcode  4000 1 50 600
ksrc   10 22.86 0
 burn   time= 0.3, 0.3, 0.4
       pfrac= 1, 1, 1
       power= 756
       mat=  1, 7, 21, 22, 24, 31, 32, 34, 41, 42, 44, 51, 52, 54, &
        61, 62, 64, 71, 72, 74, 81, 82, 84, 91, 92, 94, 101, 102, 104, &
        111, 112, 114, 121, 122, 124, 131, 132, 134, 141, 142, 144, &
        151, 152, 154, 161, 162, 164, 171, 172, 174, 181, 182, 184, &
        191, 192, 194, 201, 202, 204, 211, 212, 214, 221, 222, 224, &
        231, 232, 234, 241, 242, 244, 251, 252, 254, 261, 262, 264, &
        271, 272, 274, 281, 282, 284, 291, 292, 294, 301, 302, 304
        matvol= 4987424.24, 1500.88, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76, 12007, &
           3001.76, 3001.76, 12007, 3001.76, 3001.76
       bopt= 1.0 -14 1.0
m1    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m2    40000 0.983652
      24000 0.001757
      26000 0.03435
      50000 0.011157        $ Zircaloy-4
m3     1002.71c  2
       8016.71c  1          $ D2O - heavy water at 600k
m4     2004  1              $ helium-4
m5     1002.60c  2
       8016.60c  1          $ heavy water moderator
m6    24000 -0.190    $ chromium in SS304L
      25055 -0.020    $ manganese in SS304L
      26000 -0.695    $ iron in SS304L
```

```
      28000 -0.095    $ nickel in SS304L
m7    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ *Target Fuel* natural UO2 fuel for U=4 pins and U=5
channel
m8    24000     -0.184186
      25055     -0.019388
      26000     -0.673733
      28000     -0.092093
       1001.60c -0.003425
       8016.60c -0.027175   $ Thermal Shield -- 80% SS-304L 20% H2O
m21   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m22   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m24    92235.17c -0.006267
       92238.17c -0.87526
        8016.60c -0.118473   $ natural UO2 fuel
m31   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m32    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m34    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m41   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m42   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m44    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m51   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m52   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m54    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m61   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m62   92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m64    92235.17c -0.006267
      92238.17c -0.87526
```

```
       8016.60c -0.118473   $ natural UO2 fuel
m71    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m72    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m74     92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m81    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m82    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m84     92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m91    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m92    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m94     92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m101   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m102   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m104    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m111   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m112   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m114    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m121   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m122   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m124    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
```

```
m131  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m132  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m134    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m141  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m142  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m144    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m151  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m152  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m154    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m161  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m162  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m164    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m171  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m172  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m174    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m181  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m182  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m184    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m191  92235.17c -0.006267
```

```
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m192  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m194    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m201  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m202  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m204    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m211  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m212  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m214    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m221  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m222  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m224    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m231  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m232  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m234    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m241  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m242  92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m244    92235.17c -0.006267
      92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m251  92235.17c -0.006267
      92238.17c -0.87526
```

```
       8016.60c -0.118473   $ natural UO2 fuel
m252   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m254    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m261   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m262   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m264    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m271   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m272   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m274    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m281   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m282   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m284    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m291   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m292   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m294    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m301   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m302   92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
m304    92235.17c -0.006267
       92238.17c -0.87526
       8016.60c -0.118473   $ natural UO2 fuel
```

APPENDIX B

```
Indian 19-Element Bundle
c ** Cell Cards **
1   1  -10.2144   -1   58 -59            imp:n=1  vol=78.9937  $ fuel
2   4  -1.785E-4   1 -2   58 -59         imp:n=1   $ gap
3   2  -6.74       2 -3   58 -59         imp:n=1   $ clad
4   1  -10.2144   -4   58 -59            imp:n=1  vol=78.9937  $ fuel
5   4  -1.785E-4   4 -5   58 -59         imp:n=1   $ gap
6   2  -6.74       5 -6   58 -59         imp:n=1   $ clad
7   1  -10.2144   -7   58 -59            imp:n=1  vol=78.9937  $ fuel
8   4  -1.785E-4   7 -8   58 -59         imp:n=1   $ gap
9   2  -6.74       8 -9   58 -59         imp:n=1   $ clad
10  1  -10.2144   -10    58 -59          imp:n=1  vol=78.9937  $ fuel
11  4  -1.785E-4   10 -11   58 -59       imp:n=1   $ gap
12  2  -6.74       11 -12   58 -59       imp:n=1   $ clad
13  1  -10.2144   -13   58 -59           imp:n=1  vol=78.9937  $ fuel
14  4  -1.785E-4   13 -14   58 -59       imp:n=1   $ gap
15  2  -6.74       14 -15   58 -59       imp:n=1   $ clad
16  1  -10.2144   -16   58 -59           imp:n=1  vol=78.9937  $ fuel
17  4  -1.785E-4   16 -17   58 -59       imp:n=1   $ gap
18  2  -6.74       17 -18   58 -59       imp:n=1   $ clad
19  1  -10.2144   -19   58 -59           imp:n=1  vol=78.9937  $ fuel
20  4  -1.785E-4   19 -20   58 -59       imp:n=1   $ gap
21  2  -6.74       20 -21   58 -59       imp:n=1   $ clad
22  1  -10.2144   -22   58 -59           imp:n=1  vol=78.9937  $ fuel
23  4  -1.785E-4   22 -23   58 -59       imp:n=1   $ gap
24  2  -6.74       23 -24   58 -59       imp:n=1   $ clad
25  1  -10.2144   -25   58 -59           imp:n=1  vol=78.9937  $ fuel
26  4  -1.785E-4   25 -26   58 -59       imp:n=1   $ gap
27  2  -6.74       26 -27   58 -59       imp:n=1   $ clad
28  1  -10.2144   -28   58 -59           imp:n=1  vol=78.9937  $ fuel
29  4  -1.785E-4   28 -29   58 -59       imp:n=1   $ gap
30  2  -6.74       29 -30   58 -59       imp:n=1   $ clad
31  1  -10.2144   -31   58 -59           imp:n=1  vol=78.9937  $ fuel
32  4  -1.785E-4   31 -32   58 -59       imp:n=1   $ gap
33  2  -6.74       32 -33   58 -59       imp:n=1   $ clad
34  1  -10.2144   -34   58 -59           imp:n=1  vol=78.9937  $ fuel
35  4  -1.785E-4   34 -35   58 -59       imp:n=1   $ gap
36  2  -6.74       35 -36   58 -59       imp:n=1   $ clad
37  1  -10.2144   -37   58 -59           imp:n=1  vol=78.9937  $ fuel
38  4  -1.785E-4   37 -38   58 -59       imp:n=1   $ gap
39  2  -6.74       38 -39   58 -59       imp:n=1   $ clad
40  1  -10.2144   -40   58 -59           imp:n=1  vol=78.9937  $ fuel
41  4  -1.785E-4   40 -41   58 -59       imp:n=1   $ gap
42  2  -6.74       41 -42   58 -59       imp:n=1   $ clad
43  1  -10.2144   -43   58 -59           imp:n=1  vol=78.9937  $ fuel
44  4  -1.785E-4   43 -44   58 -59       imp:n=1   $ gap
45  2  -6.74       44 -45   58 -59       imp:n=1   $ clad
46  1  -10.2144   -46   58 -59           imp:n=1  vol=78.9937  $ fuel
47  4  -1.785E-4   46 -47   58 -59       imp:n=1   $ gap
48  2  -6.74       47 -48   58 -59       imp:n=1   $ clad
49  1  -10.2144   -49   58 -59           imp:n=1  vol=78.9937  $ fuel
50  4  -1.785E-4   49 -50   58 -59       imp:n=1   $ gap
```

```
51  2  -6.74       50 -51   58 -59        imp:n=1   $ clad
52  1  -10.2144   -52   58 -59           imp:n=1  vol=78.9937  $ fuel
53  4  -1.785E-4   52 -53   58 -59        imp:n=1   $ gap
54  2  -6.74       53 -54   58 -59        imp:n=1   $ clad
55  1  -10.2144   -55   58 -59           imp:n=1  vol=78.9937  $ fuel
56  4  -1.785E-4   55 -56   58 -59        imp:n=1   $ gap
57  2  -6.74       56 -57   58 -59        imp:n=1   $ clad
58  2  -6.74       -3  81 -58             imp:n=1   $ clad bottom disc
59  2  -6.74       -3  59 -82             imp:n=1   $ clad top disc
60  2  -6.74       -6  81 -58             imp:n=1   $ clad bottom disc
61  2  -6.74       -6  59 -82             imp:n=1   $ clad top disc
62  2  -6.74       -9  81 -58             imp:n=1   $ clad bottom disc
63  2  -6.74       -9  59 -82             imp:n=1   $ clad top disc
64  2  -6.74       -12 81 -58             imp:n=1   $ clad bottom disc
65  2  -6.74       -12 59 -82             imp:n=1   $ clad top disc
66  2  -6.74       -15 81 -58             imp:n=1   $ clad bottom disc
67  2  -6.74       -15 59 -82             imp:n=1   $ clad top disc
68  2  -6.74       -18 81 -58             imp:n=1   $ clad bottom disc
69  2  -6.74       -18 59 -82             imp:n=1   $ clad top disc
70  2  -6.74       -21 81 -58             imp:n=1   $ clad bottom disc
71  2  -6.74       -21 59 -82             imp:n=1   $ clad top disc
72  2  -6.74       -24 81 -58             imp:n=1   $ clad bottom disc
73  2  -6.74       -24 59 -82             imp:n=1   $ clad top disc
74  2  -6.74       -27 81 -58             imp:n=1   $ clad bottom disc
75  2  -6.74       -27 59 -82             imp:n=1   $ clad top disc
76  2  -6.74       -30 81 -58             imp:n=1   $ clad bottom disc
77  2  -6.74       -30 59 -82             imp:n=1   $ clad top disc
78  2  -6.74       -33 81 -58             imp:n=1   $ clad bottom disc
79  2  -6.74       -33 59 -82             imp:n=1   $ clad top disc
80  2  -6.74       -36 81 -58             imp:n=1   $ clad bottom disc
81  2  -6.74       -36 59 -82             imp:n=1   $ clad top disc
82  2  -6.74       -39 81 -58             imp:n=1   $ clad bottom disc
83  2  -6.74       -39 59 -82             imp:n=1   $ clad top disc
84  2  -6.74       -42 81 -58             imp:n=1   $ clad bottom disc
85  2  -6.74       -42 59 -82             imp:n=1   $ clad top disc
86  2  -6.74       -45 81 -58             imp:n=1   $ clad bottom disc
87  2  -6.74       -45 59 -82             imp:n=1   $ clad top disc
88  2  -6.74       -48 81 -58             imp:n=1   $ clad bottom disc
89  2  -6.74       -48 59 -82             imp:n=1   $ clad top disc
90  2  -6.74       -51 81 -58             imp:n=1   $ clad bottom disc
91  2  -6.74       -51 59 -82             imp:n=1   $ clad top disc
92  2  -6.74       -54 81 -58             imp:n=1   $ clad bottom disc
93  2  -6.74       -54 59 -82             imp:n=1   $ clad top disc
94  2  -6.74       -57 81 -58             imp:n=1   $ clad bottom disc
95  2  -6.74       -57 59 -82             imp:n=1   $ clad top disc
96  3  -0.8143 3 6 9 12 15 18 21 24 27 30 33 36 39 42 45 48 51 54 57 &
                       (81 -82) -61        imp:n=1   $ D2O coolant inside bundle
97  2  -6.74 65 -66 61 -62                imp:n=1   $ pressure tube (PT)
98  0        65 -66 62 -63                imp:n=1   $ PT-CT gap
99  2  -6.74 65 -66 63 -64                imp:n=1   $ Calandria tube (CT)
100 3  -0.8143 -81 65 -61                 imp:n=1   $ End coolant D2O
101 3  -0.8143 -66 82 -61                 imp:n=1   $ End coolant D2O
102 5 -1.1 77 -78 79 -80 65 -66 64        imp:n=1   $ D2O moderator box lattice
103 0 -65:66:-77:78:-79:80 imp:n=0 $ outside world where neutrons are not tracked
```

```
c ** Surface Cards **
1    cx   0.72                        $ fuel radius    -- center pin
2    cx   0.722                       $ clad inner rad -- center pin
3    cx   0.76                        $ clad outer rad -- center pin
4    c/x  0 1.65 0.72                 $ first ring pins...
5    c/x  0 1.65 0.722
6    c/x  0 1.65 0.76
7    c/x  1.42894 0.825 0.72
8    c/x  1.42894 0.825 0.722
9    c/x  1.42894 0.825 0.76
10   c/x  1.42894 -0.825 0.72
11   c/x  1.42894 -0.825 0.722
12   c/x  1.42894 -0.825 0.76
13   c/x  0 -1.65 0.72
14   c/x  0 -1.65 0.722
15   c/x  0 -1.65 0.76
16   c/x  -1.42894 -0.825 0.72
17   c/x  -1.42894 -0.825 0.722
18   c/x  -1.42894 -0.825 0.76
19   c/x  -1.42894 0.825 0.72
20   c/x  -1.42894 0.825 0.722
21   c/x  -1.42894 0.825 0.76         $ ... first ring pins
22   c/x  3.07164 0.823045 0.72       $ second ring pins...
23   c/x  3.07164 0.823045 0.722
24   c/x  3.07164 0.823045 0.76
25   c/x  2.2486 2.2486 0.72
26   c/x  2.2486 2.2486 0.722
27   c/x  2.2486 2.2486 0.76
28   c/x  0.823045 3.07164 0.72
29   c/x  0.823045 3.07164 0.722
30   c/x  0.823045 3.07164 0.76
31   c/x  -0.823045 3.07164 0.72
32   c/x  -0.823045 3.07164 0.722
33   c/x  -0.823045 3.07164 0.76
34   c/x  -2.2486 2.2486 0.72
35   c/x  -2.2486 2.2486 0.722
36   c/x  -2.2486 2.2486 0.76
37   c/x  -3.07164 0.823045 0.72
38   c/x  -3.07164 0.823045 0.722
39   c/x  -3.07164 0.823045 0.76
40   c/x  -3.07164 -0.823045 0.72
41   c/x  -3.07164 -0.823045 0.722
42   c/x  -3.07164 -0.823045 0.76
43   c/x  -2.2486 -2.2486 0.72
44   c/x  -2.2486 -2.2486 0.722
45   c/x  -2.2486 -2.2486 0.76
46   c/x  -0.823045 -3.07164 0.72
47   c/x  -0.823045 -3.07164 0.722
48   c/x  -0.823045 -3.07164 0.76
49   c/x  0.823045 -3.07164 0.72
50   c/x  0.823045 -3.07164 0.722
51   c/x  0.823045 -3.07164 0.76
52   c/x  2.2486 -2.2486 0.72
53   c/x  2.2486 -2.2486 0.722
54   c/x  2.2486 -2.2486 0.76
```

```
55   c/x  3.07164 -0.823045 0.72
56   c/x  3.07164 -0.823045 0.722
57   c/x  3.07164 -0.823045 0.76       $ ... second ring pins
58   px   -24.209                      $ rear of bundle
59   px    24.209                      $ front of bundle
61   cx   4.13                         $ pressure tube inner radius
62   cx   4.55                         $ pressure tube outer radius
63   cx   5.4                          $ calandria tube inner radius
64   cx   5.55                         $ calandria tube outer radius
*65   px   -24.75                      $ spacer
*66   px    24.75                      $ spacer
*77   py   -11.43                       $ side of box lattice
*78   py    11.43                       $ side of box lattice
*79   pz   -11.43                       $ side of box lattice
*80   pz    11.43                       $ side of box lattice
81   px   -24.25                       $ rear of  bundle but with 0.041cm clad
82   px    24.25                       $ front of  bundle but with 0.041cm clad

c ** Data Cards **
kcode  5000 1 100 2000
ksrc   0 0 0
burn   time= 0.3, 0.3, 0.4, 3, 5, 5, 5, 5
       pfrac= 1, 1, 1, 1, 1, 1, 1, 1
       power= 0.56889
       mat=  1
       matvol= 1498.219
       bopt= 1.0 24 1.0
m1   92235.17c -0.006267
     92238.17c -0.87526
      8016.60c -0.118473   $ natural UO2 fuel
m2    40000 0.983652
      24000 0.001757
      26000 0.03435
      50000 0.011157        $ Zircaloy-4
m3     1002.71c  2
       8016.71c  1          $ D2O - heavy water at 600k coolant
m4     2004  1              $ helium-4
m5     1002.70c  2
       8016.70c  1          $ heavy water moderator 300K
```